ROYAL
BOTANIC GARDENS
VICTORIA

Muelleria

Plant, Algal and Fungal Taxonomy and Systematics

Vol 38, 2019–2020

***Phebalium squamulosum* Vent., *Jard. Malmaison* 2: t. 102 (1805)**
Source: State Botanical Collection
Illustration: Anita Barley (circa 1978)

The Forest Phebalium, *Phebalium squamulosum*, was described 'from the mountains of New South Wales' by French botanist Étienne Ventenat in his two volume *Jardin de la Malmaison*, a work documenting the flora held in the grounds of the Château de Malmaison, residence of Joséphine de Beauharnais, then Empress consort of the French. This illustration was created for the *Illustrated Flora of Victoria* project, much of which has now been integrated into VicFlora, the modern portal to the Flora of Victoria.

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Instructions to authors	Please consult the instructions to authors on our website: www.rbg.vic.gov.au/science/publications/muelleria A concise version is printed inside the back cover of each issue.
Publication frequency	One issue per year
Subscription rates	The following rates include postage and GST. All payments must be in $AUD. Cheques should be made payable to the Royal Botanic Gardens Victoria. Contact the Subscription Manager for additional payment options.

	Australia	International
Individuals	$40	$62
Organisations	$50	$77

Layout	SUBStitution Pty Ltd
Printer	tmp
Printed on recycled paper	

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Where a paper in this issue was first published online, the publishing date is specified on the title page.

ISSN 0077-1813

Muelleria

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Published online in advance of the print edition, 20 August 2019

ROYAL BOTANIC GARDENS VICTORIA

Three new species segregated from *Phebalium squamulosum* subsp. *squamulosum* (Rutaceae) based on morphological and phytochemical data

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Introduction

The genus *Phebalium* Vent. is widespread through southern and eastern Australia with 28 species recognised in the 'Flora of Australia' (Wilson 2013) and 30 recognised by APC (2016). Several species, in particular *Phebalium squamulosum* Vent., exhibit considerable morphological variation. In the last major revision of the genus, Wilson (1970) recognised nine subspecies, with eight of these maintained in his treatment for 'Flora of Australia' (Wilson 2013). Telford and Bruhl (2014) subsequently raised *P. squamulosum* subsp. *verrucosum* Paul G.Wilson to the rank of species.

The type specimen of *P. squamulosum* was taken from a plant cultivated in Empress Josephine's garden at Malmaison, France, from a collection from the Sydney area, "originaire de la Nouvelle Galles, et croissant sur les montagnes" (Ventenat 1805). A lectotype was selected by Callmander *et al.* (2017), which includes an image of an isolectotype.

In his treatment of *P. squamulosum* subsp. *squamulosum*, Wilson (1970) included lowland plants of the Sydney Basin as well as plants from south-eastern Queensland and high altitudes of the New England Tableland,

Abstract

Phebalium graniticola I.Telford & J.J.Bruhl, *P. stellatum* I.Telford & J.J.Bruhl and *P. sylvaticum* I.Telford & J.J.Bruhl are segregated as new species from *Phebalium squamulosum* Vent. subsp. *squamulosum*. Essential oil data support the recognition of these species as distinct. Distributions of the new species are mapped, and their habitat and conservation status discussed. A table comparing selected morphological attributes of the new species with *P. squamulosum* subsp. *squamulosum* is provided.

Key words: biodiversity, conservation, essential oils, plant systematics, taxonomy

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

New South Wales, noting (Wilson 1970: 82): "This subspecies, as here delimited, includes several different forms which may warrant recognition, but as some of these forms are known only from single collections it appears unwise at the moment to further fragment the species." Extensive, additional material collected since then allows critical reassessment of delimitation of the subspecies.

Investigation of the *P. squamulosum* complex in Queensland by Forster (2003) has shown that additional collections have allowed a clearer pattern of discontinuous variation to emerge. Forster used morphological discontinuities, and geographic and ecological disjunctions to argue for raising several subspecies to specific rank within *Phebalium* (Forster 2003) and *Philotheca* Rudge (Forster 2005). Forster (2003) segregated *Phebalium distans* P.I.Forst. from *P. squamulosum* subsp. *squamulosum*, and reinstated *P. longifolium* S.T.Blake as a species. He also drew attention to two groups of populations from near Dorrigo, New South Wales and Mount Ballow, Queensland in need of further study. Here we investigate the status of these populations.

Leaf essential oil composition has provided insights into relationships in *Phebalium* (Brophy *et al*. 2006; Pala-Paul *et al*. 2009; Sadgrove *et al*. 2013, 2014). The first analysis of essential oils from *P. squamulosum* was undertaken by Batey *et al*. (1971), with a novel sesquiterpene ketone that they named squamulosone found to be the major constituent. Although no subspecies was specified in that study and no voucher cited, the locality of collection (Narrabeen, Sydney) places it as *P. squamulosum* subsp. *squamulosum*.

Brophy *et al*. (2006) reported no squamulosone present in oils from samples from Queensland assigned to *P. squamulosum* subsp. *squamulosum*; major components were elemol/hedycaryol and isomers of eudesmol. The two related sesquiterpenes elemol and hedycaryol were first reported in *Phebalium* by Southwell (1970) from a Blue Mountains sample of *P. ozothamnoides* F.Muell., currently referred to *P. squamulosum* subsp. *ozothamnoides* (F.Muell.) Paul G.Wilson (Wilson 2013). Southwell (1970) demonstrated that elemol is the heat product of hedycaryol formed in hydrodistillation, yielding an essential oil with a mixture of the two. Elemol and hedycaryol are generally reported together in analyses because they are not effectively separated in chromatography.

In curating *Phebalium* in herbarium NE, we assigned the plants from the unallocated populations referred to by Forster (2003) as putative new species. Composition of the essential oils of these, *P. stellatum* I.Telford & J.J.Bruhl from near Dorrigo New South Wales, and *P. sylvaticum* I.Telford & J.J.Bruhl from Gibraltar Range, New South Wales, was assessed by Pala-Paul *et al.* (2009) but no comparisons were made with oils from other populations currently assigned to *P. squamulosum* subsp. *squamulosum*. In their analyses, the oils of *P. stellatum* and *P. sylvaticum* show a similar composition; both lack squamulosone and contain some measure of hedycaryol/elemol, but major components and proportions of chemicals differed. *Phebalium stellatum*. yielded essential oils characterised by a significantly higher proportion of monoterpenes, where α-pinene and myrcene represented the major monoterpenes. In contrast, the chemical character of volatiles from *P. sylvaticum* demonstrated collectively higher proportions of hedycaryol/elemol, eudesmol isomers and other oxygenated sesquiterpenes such as guaiol and bulnesol (Table 1).

Sadgrove *et al*. (2014) found populations from the New England Tableland, therein assigned to *P. squamulosum* subsp. *squamulosum* – below named as a new species, *P. graniticola* I.Telford & J.J.Bruhl – yielded elemol and eudesmol as major components but also lacked squamulosone (Table 1). Comparison with other samples of *P. squamulosum* subsp. *squamulosum* indicates the name encompasses several chemotypes, and probably constitutes a heterogeneous species aggregate. The two sesquiterpene rich oils from *P. sylvaticum* and *P. graniticola* are differentiated by elemol/hedycaryol, with a lower proportion in the latter species, together with moderate to high concentrations of globulol. Ledol (the epimer of globulol) was observed in trace quantities in *P. sylvaticum*, but generally this azulenic group only occurs in *P. squamulosum* subsp. *squamulosum* sampled in the study by Sadgrove *et al*. (2014).

In this paper, we are not presenting a full revision of the species, or even of the subspecies *P. squamulosum* subsp. *squamulosum*. Although we value highly comprehensive taxonomic revisions, we are publishing

Table 1. Comparison of major essential oil components of leaves of *Phebalium graniticola, P. stellatum* and *P. sylvaticum*. Data for *P. stellatum* and *P. sylvaticum* from Pala-Paul *et al.* (2009); for *P. graniticola,*from Sadgrove *et al.* (2014).

Essential oil component	*P. stellatum*	*P. sylvaticum*	*P. graniticola~*
α-pinene	-	7.1–8.9	0.2–3.4
camphene	0.5–3	1.6–2.6	-
γ-3-carene	4.4–13.7	8.0–11.5	-
myrcene	0.1-2.8	10.6–23.0	0.9–6.0
limonene	1.3–1.7	2.1–2.5	-
β-phellendrene	5.2–10.8	0.5–14.8	0.2–7.1
geijerene	0.1–0.2	0.1	-
bicyclogermacrene	1.8–2.7	0.9–1.6	0–0.5
elemol/hedycaryol*	29.1–40.6	18.7–23.9	5.7–18.7
globulol	-	-	6.3–33.3
ledol	-	0.1–0.3	-
guaiol	1.7–6.1	0.7–1.4	1.5–3.9
bulnesol	2.5–5.9	0.7–1.0	2.3–3.1
γ-eudesmol	5.4–8.2	2.2–3.5	1.5–13.1
β-eudesmol	6.1–10.0	6.7–9.1	1.4–16.3
α-eudesmol	5.5–8.6	2.8–3.8	1.9–9.8
Monoterpenes #	24.3–31.4	50.1–58.5	1.4–23.0
Oxygenated monoterpenes #	0.2–0.4	1.3–2.5	0.2–1.8
Sesquiterpenes #	3.4–4.4	1.6–3.0	2.6–7.3
Oxygenated sesquiterepenes #	61.1–69	33.9–43.7	58.9–91.4

* Different chromatographic methods were employed across the studies summarised here. Where a DB-WAX column was used, separation of elemol and hedycaryol was achieved (Pala-Paul et al. 2009) but not where a HP-5MS was used (Sadgrove et al. 2014). Owing to the interchangeability of elemol/hedycaryol in hydrodistillation (Southwell 1970), the two are combined to aid comparison.

\# These values are taken from Pala-Paul et al. (2009) and raw data included as supplementary material in the study by Sadgrove et al. (2014).

~ Treated in Sadgrove *et al.* (2014) as *P. squamulosum* subsp. *squamulosum*.

three distinct species from northern New South Wales and southern Queensland to address immediate conservation and management concerns. In this regard, we agree with Messina and Walsh (2019) and point to the constructive conservation outcome for *Phebalium speciosum* I.Telford (Telford 2013) that was segregated from the *P. nottii* (F.Muell.) Maiden & Betche complex without a full revision of that group. It has since been gazetted as "Critically Endangered" (NSW Scientific Committee report; https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20320) and is subject to active management under the Saving Our Species program of the Office of Environment and Heritage (pers. comm. James Brazill-Boast).

Materials and methods

Morphological data

Morphological data was derived from herbarium specimens held in BRI, CANB, CFSHB, NE and NSW (codes follow Index Herbariorum; http://sweetgum.nybg.org/science/ih/). Images of seeds were taken using a Nikon SMZ25 microscope, 1.0x objective, with bright field illumination. The plate (Figure 1) was constructed using paint.net v.4.0.13 and Inkscape v.0.91.

Essential oil data

Data on essential oil composition are from Pala-Paul *et al.* (2009) and Sadgrove *et al.* (2014) and we tabulate combined, selected results below.

Results and discussion

Trichome form and distribution appear to be taxonomically informative in defining taxa in *Phebalium*. All material currently assigned to *Phebalium squamulosum* subsp. *squamulosum* have peltate, lepidote trichomes in varying degrees. Lepidote trichomes in the study group exhibit more or less entire, erose and fimbriate scale margins, and variation in

rufous colouration. Only in populations near Cascade, New South Wales such rufous lepidote trichomes are sparse, while colourless stellate trichomes consitute most of the indumentum on the abaxial surface of leaves. Specimens from the Bucketty to Mogo Creek area, Central Coast, New South Wales, possess some stellate trichomes, but in other leaf and seed characters are more like *P. squamulosum* subsp. *squamulosum s. str.*, and may represent a new taxon. The variation, development and evolution of trichomes merits further study (cf. Lander 1984).

Vegetative and floral differences (Table 2), together with the differences in seed morphology of size, shape and ornamentation (Figure 1) indicate new species are merited to accommodate three groups of populations from northern New South Wales and adjacent Queensland, which we name below.

Segregation of three putative new species from *P. squamulosum* subsp. *squamulosum* on this morphological evidence is corroborated by phytochemical data (Table 1). Species recognised here are sampled for phytochemistry from at least two individuals (Pala-Paul *et al.* 2009; Sadgrove *et al.* 2014) and up to five individuals from one or two populations. The high level of similarity of chemical profiles within a taxon and the obvious dissimilarity between taxa provides confidence that this line of evidence is congruent with discontinuities in morphology across taxa, that we recognise here as species.

The sesquiterpene ketone, squamulosone, was isolated from essential oils in high yield from the type variant of *P. squamulosum* (Batey *et al.* 1971). All three of the new species lack squamulosone as a component of their essential oils.

The three new species differ in the proportion of their essential oil components (Table 1). In Sadgrove *et al.* (2014) samples from Bluff Rock and Donnybrook, near Tenterfield, New South Wales, were referred to *P. squamulosum* subsp. *squamulosum* Chemotype B, but are here named as the new species, *P. graniticola*.

Total monoterpenes are substantially higher in *P. sylvaticum* compared with those from *P. stellatum* and *P. graniticola*. Globulol is present in oils from *P. graniticola* in moderate to high amounts but absent in *P. stellatum* and *P. sylvaticum*. *Phebalium graniticola* has substantially less elemol/hedycaryol than *P. stellatum* and *P. sylvaticum*.

The morphological and phytochemical evidence together provides strong support for the segregation from *P. squamulosum* subsp. *squamulosum* of the three species described below as new: *P. graniticola*, *P. stellatum* and *P. sylvaticum*.

This paper is the second in an ongoing study of *Phebalium squamulosum*. Our field, herbarium and laboratory studies indicate that *P. squamulosum* subsp. *squamulosum* is restricted to the Sydney Basin and that the other currently recognised subspecies each represents at least one species. In addition, there are entirely new entities we have segregated at the N.C.W. Beadle Herbarium, including those currently assigned to *P. squamulosum* subsp. *squamulosum* in central and southern New South Wales, Victoria and South Australia. A student has commenced a PhD candidature in April 2019 in Botany and the N.C.W. Beadle Herbarium,

Table 2. Comparison of selected morphological attributes of *Phebalium graniticola*, *P. stellatum*, *P. sylvaticum* and *P. squamulosum* subsp. *squamulosum s.str*.

Attribute	*P. graniticola*	*P. stellatum*	*P. sylvaticum*	*P. squamulosum* subsp. *squamulosum s. str.*
Habit	shrub to 3 m	shrub or tree to 8 m	shrub or tree to 7 m	shrub to 2.5 m
Leaf shape	elliptic	lanceolate	lanceolate, rarely elliptic	elliptic
Leaf lamina length (mm)	4.3–27.5	(35–)50–85(–117)	(17–)30–70(–80)	8–34
Trichomes of leaf abaxial surface	lepidote	stellate and lepidote	lepidote	lepidote
Leaf margin	irregularly dentate	entire	entire to sinuate	entire
Calyx surface	lepidote and verruculose	lepidote	lepidote	lepidote
Petal length (mm)	2.8–3.5	2.5–3	3.5–4.2	3–4
Seed length (mm)	2.2–2.6	2.0–2.3	2.2–2.7	2.4–2.6

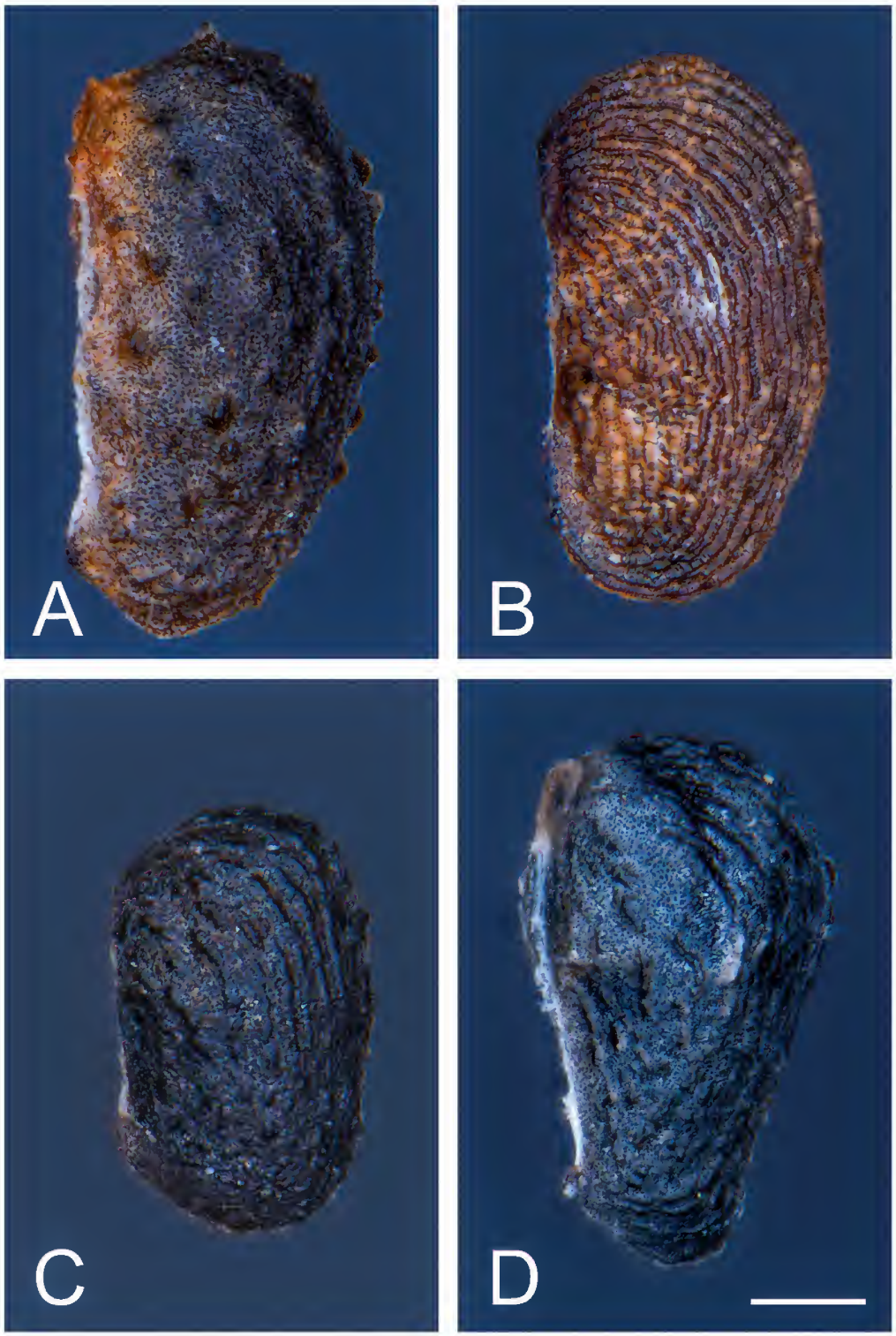

Figure 1. A: Seed of *Phebalium graniticola* (*I.R. Telford 13122*, NE). B: Seed of *P. squamulosum* subsp. *squamulosum* (*J.B. Williams s.n.*, NE28996). C: Seed of *P. stellatum* (*J.J. Bruhl 3513*, NE). D: Seed of *P. sylvaticum* (*J.J.Bruhl 3514*, NE). Scale bar = 0.5 mm.

University of New England. This research project will add molecular data as well as more morphological and phytochemical data, leading to a comprehensive revision of the group as part of systematic study of *Phebalium* in eastern Australia.

Taxonomy

In this section, citation of specimens follows regional categories used by respective State herbaria, while distributional data follow IBRA Bioregions (https://www.environment.gov.au/land/nrs/science/ibra).

Phebalium graniticola I.Telford & J.J.Bruhl, sp. nov.

P. squamulosum subsp. *squamulosum auct. non* Vent.: Wilson (1970, 2013) *p.p.*, excluding all populations other than those from the Granite Belt of Qld and the North Western Slopes and Northern Tablelands (not including Barrington Tops) of N.S.W.; Weston & Porteners (1991: 258) p.p. ibid.; Weston & Harden (2002: 303) p.p. ibid.

***Type*: NEW SOUTH WALES:** Northern Tablelands: alongside Blather Creek near Blatherarm Road, Torrington State Recreation Area (now Torrington State Conservation Area), *J.R. Hosking 1610 & G.R. Hosking*, 7 Oct. 1998; holo: NSW; iso: BRI, CANB, MEL (MEL283130), NE (NE68575), NSW.

Diagnosis: differing from *P. squamulosum* Vent. subsp. *squamulosum s. str.* in its leaf margins (irregularly dentate vs entire), calyx rim (broad triangular lobes vs truncate), seed ornamentation (verruculose with few longitudinal ridges vs not verruculose and with many longitudinal ridges), and its leaf essential oil (the absence of squamulosone). *Shrubs*, stems erect, to 3 m tall. *Bark* ±smooth, red-brown to grey-brown with paler longitudinal lenticels. *Branchlets* densely silvery and rufous lepidote. *Leaves*: petiole 1.2–3.5 mm long, densely silvery and rufous lepidote; lamina elliptic, 4.3–27.5 mm long, 2.2–6.0 mm wide, apically rounded or truncate, mucronate, margins irregularly dentate, ±recurved, adaxial surface with midrib impressed, silvery lepidote on young leaves, glabrescent, glossy green, sparsely scabridulous with remnant bases of scales and the epidermis raised into obtuse to acute protuberances above the glands, abaxial surface silvery and rufous lepidote. *Inflorescence* terminal, of a single (3–)5–8(–13)-flowered umbel, sessile or peduncle to 1.5 mm long; pedicels 4.5–7(–15) mm long, densely silvery and rufous lepidote. *Calyx* shallowly cup-shaped, 0.8–1.0 mm long, 1.6–2.8 mm diam., verruculose and lepidote with 5 broadly triangular lobes often obscured by lepidote trichomes. *Corolla* of 5 free petals; petals elliptic, 2.8–3.5mm long, 1.3–2.0 mm wide, shortly acuminate, adaxial surface glabrous, yellow, abaxial surface densely silvery and rufous lepidote. *Stamens* 10; filaments filiform, 5.0–5.8 mm long, glabrous; anthers elliptic, c. 1.2 mm long; apical gland minute, globose. *Ovary* subglobose, c. 1 mm diam., of 5 carpels, silvery lepidote; style c. 3 mm long, terete, glabrous; stigma minutely capitate. *Fruit* a capsular schizocarp of up to 5 erect cocci; cocci compressed obovoid, 3–3.5 mm long, 2–2.4 mm wide, truncate with an apical beak c. 1.5 mm long, silvery and ferruginous lepidote. *Seeds* compressed ovoid, 2.2–2.6 mm long, 1.3–1.6 mm wide, verruculose and with few discontinuous, longitudinal ridges on the outer face, dull dark grey. (Figs 1A, 2)

***Specimens examined (selection)*: QUEENSLAND**: Darling Downs: Amiens, 10 miles NW of Stanthorpe, *L. Pedley 1488A*, 30 Oct. 1963 (BRI); Slopes near summit of Mount Norman, Girraween National Park, *J.M. Powell 1062 & J.A. Armstrong*, 27 Sep. 1977 (BRI, NSW). **NEW SOUTH WALES**: Northern Tablelands: Bald Rock State Park, 23 km N of Tenterfield, *R.G. Coveny 5728 & N.Lander*, 3 Oct. 1974 (CANB, NE, NSW); Roberts Range, c. 27 km WNW of Tenterfield, 5 km along track to Donnybrook Plateau from Back Creek Road, *I.R. Telford 13122, J.J. Bruhl, M. Badham & D. Caldwell*, 20 Dec. 2006 (BRI, CANB, HO, NE, NSW); Jonquil Knob, Torrington State Recreation Area, off Duck Creek Trail, *P.I. Forster 27439*, 12 July 2001 (BRI, MEL, NE, NSW); 2.3 km along Blatherarm Road from Torrington to Silent Grove road, Torrington State Recreation Area, *R. Johnstone 1499 & A.E. Orme*, 31 Dec. 2004 (K, NE, NSW); Bluff Rock, 13 km S of Tenterfield, *N.J. Sadgrove 303*, 28 Oct. 2012; Cathedral Rock, 10 km N of Ebor, *J.B. Williams NE51584*, Oct. 1974 (NE); North Western Slopes: The Barbs, c. 20 km ESE of Ashford, *B.J. Lepschi 5007 & A. Whalen*, 15 Sep. 2003 (AUA, CANB, DAO, NE, NSW, NY); 'Willows', Bonshaw road, c. 43 km WNW of Glen Innes, *G.J. White NE56114*, 19 Aug. 1992 (NE); 'Rockview South', E of Barraba, *J.T. Hunter s.n. & V.H. Hunter NE105028*, 22 Apr. 2017 (BRI, NE, NSW).

***Distribution*:** *Phebalium graniticola* is widespread through the New England Bioregion from Amiens, NW of Stanthorpe, Queensland, south to Cathedral Rock, near Ebor, New South Wales, west to near Barraba and Inverell, New South Wales.

Habitat*:* *Phebalium graniticola* grows in dry heath and *Eucalyptus* woodland mostly on granite, rarely on

N.C.W. BEADLE HERBARIUM
NE 68575
UNIV. OF NEW ENGLAND AUSTRALIA
N.C.W. Beadle Herbarium (NE)
University of New England
ISOTYPE
Phebalium graniticola I.Telford & J.J.Bruhl
Det.: I.C.H. Telford
18 Jan. 2017
ex TAMWORTH AGRICULTURAL RESEARCH CENTRE HERBARIUM (TARCH)
Phebalium squamulosum Vent. subsp. squamulosum
Det.: JRH
Loc. alongside Blather Creek near Blatherarm Road, Torrington State Recreation Area
NSW Subdivision: NT
Lat. 29° 15' 38"S Long. 151° 42' 21"E, Alt. 1035 m
Coll. J. R. Hosking 1610 & G. R. Hosking
Date 7 October 1998
Notes Locally frequent (>100 in collection area) shrub to 1.5 m high. Leaves green above with yellowish spots and silvery below with brown stellate hairs. Flowers with 5 petals, yellow above and yellow with large brown scales below.
Landform: gully
Substrate: granite
Soil: brown and white sandy loam
Vegetation: from shrubby Eucalyptus spp. woodland growing with Calytrix tetragona Labill. (J. R. Hosking 1611 & G. R. Hosking), Styphelia triflora Andrews, Leucopogon sp. and Acacia sp.
Identity confirmed by J. R. Hosking using NSW (main collection) on 20 November 1998
Dupl. to:
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cm 0 1 2 3 4 5 6 7 8 9 10

Figure 2. Isotype of *Phebalium graniticola* I.Telford & J.J.Bruhl (NE).

metasediments (Donnybrook Plateau, Severn River Gorge). This species occurs at 580–1550 m altitude, mostly on high rocky sites, following suitable habitats near streams to the lower altitudes. Associated species include *Acacia neriifolia* A.Cunn. ex Benth., *A. torringtonensis* Tindale (Torrington only), *Callitris endlicheri* (Parl.) F.M.Bailey, *Calytrix tetragona* Labill., *Eucalyptus andrewsii* Maiden, *E. prava* L.A.S.Johnson & K.D.Hill, *E. youmanii* Blakely & McKie, *Leptospermum brevipes* F.Muell., *L. trinervium* (Sm.) Joy Thomps., *Prostanthera petraea* B.J.Conn (Bald Rock only) and *Styphelia triflora* Andrews.

Phenology: *Phebalium graniticola* flowers August–October; fruits December–January.

Conservation status: The species is widespread and common with populations of many individuals and thus is considered to be of "Least Concern" (IUCN 2017). It is conserved in Girraween National Park in Queensland, Bald Rock and Cathedral Rock National Parks, Torrington State Conservation Area and Bolivia Hill Nature Reserve in New South Wales.

Etymology: The epithet is from the Latin *granitum* (granite) and *-cola* (a dweller), referring to the species preference for granitic habitats.

Phebalium stellatum I.Telford & J.J.Bruhl sp. nov.

P. squamulosum subsp. *squamulosum auct. non* Vent.: Wilson (1970; 2013) *p.p.*, excluding all populations other than those in the vicinity of Cascade near Dorrigo, N.S.W.; Weston & Porteners (1991: 258) *p.p. ibid.*, and all illustrations except 2a, right hand leaf only; Weston & Harden (2002: 303) *p.p., ibid.*

***Type*: NEW SOUTH WALES**. North Coast: Wild Cattle Creek State Forest, 200 m along Callitris Rd from Morora Rd, 2.5 km ENE of Cascade, *I.R. Telford 12938 & J.J. Bruhl*, 10 Sep. 2006; holo: NSW; iso: BRI, CANB, HO, K, MEL (MEL2380142), MO, NE (NE88775), PERTH.

Diagnosis: differs from *P. squamulosum* Vent. subsp. *squamulosum s. str.* in the presence of stellate trichomes on branchlets and leaves, larger, lanceolate leaves (35–117 vs 8–34 mm long), smaller flowers (petals 2.5–3 vs 3–4 mm long), smaller seeds (2–2.3 vs 2.4–2.6 mm long) with fewer longitudinal ridges, and the absence of squamulosone from its leaf essential oil.

Shrubs or trees, stems erect to 8 m tall. *Bark* grey-brown, ±smooth roughen slightly by paler lenticels. Branchlets densely white lepidote to stellate hairy. *Leaves*: petioles 2–5 mm long; laminas narrowly lanceolate, (35–)50–85(–117) mm long, (3.5–)7.5–10(–15) mm wide, acute, margin straight or shallowly crenate, flat or slightly recurved; adaxial surface with midrib impressed, sparsely stellate, glabrescent, dull; slightly raised and rounded above the glands, abaxial surface densely white stellate hairy and rufous lepidote becoming predominately white stellate hairy at maturity. *Inflorescence* terminal, of up to five 4–8-flowered umbels, the adjacent upper axils with solitary umbels; peduncles 3–10 mm long, densely silvery lepidote; pedicels 3–7.4 mm long, densely silvery lepidote. *Calyx* broadly cup-shaped, c. 0.8 mm long, c. 1.5 mm diam., truncate or scarcely 5-lobed, densely silvery lepidote. *Corolla* of 5 free petals; petals elliptic, 2.5–3 mm long, 1.2–1.5 mm wide, apiculate, the adaxial surface glabrous, cream–pale yellow; abaxial surface densely silvery and ferrugineous lepidote. *Stamens* 10; filaments filiform, 3.5–5.5 mm long, glabrous; anthers elliptic, c. 0.6 mm long, apical gland minute, globose. *Ovary* subglobose, 1–1.2 mm diam., of 5 carpels, silvery lepidote and stellate hairy; style filiform, c. 3.5 mm long, with sparse stellate trichomes towards base; stigma truncate. *Fruit* a capsular schizocarp of up to 5 erect cocci; cocci compressed obovoid, 2.2–2.8 mm long, 1.8–2.5 mm wide, truncate, silvery and rufous lepidote. Seeds compressed obovoid, 2.0–2.3 mm long, 1.3–1.5 mm wide, with discontinuous longitudinal ridges mainly on the outer face, glossy black. (Figs 1C, 3, 4)

Specimens examined (selection): NEW SOUTH WALES: North Coast: Wild Cattle Creek State Forest, Mobong Rd, 2.5 km from junction with Measuring Hut Rd, *S. Griffith s.n*, 3 Sep. 1991 (BRI, NE, NSW); Wild Cattle Creek State Forest, 8.5 km along Moses Rock Rd from Cascade, *I.R. Telford 12945 & J.J. Bruhl,* 10 Sep. 2006 (BRI, CANB, HO, MEL, NE, NSW, PERTH); Morora Rd, 4.4 km E of Cascade via Dorrigo, *A.R. Bean 16875*, 10 Sep. 2000 (BRI, CANB, MEL, NSW); Dorrigo State Forest, hillsides above Wild Cattle Creek, *C. White 7561*, 4 Oct. 1930 (BRI); Urumbilum River, Orara West State Forest [now Bindari National Park], *A. Floyd s.n.*, 9 Sep. 1972 (CFSHB).

Distribution: *Phebalium stellatum* is restricted to the mountainous country within 20 km of Cascade, N of Dorrigo, in the New South Wales North Coast Bioregion, New South Wales.

Phenology: The species flowers August–September; fruits December.

N.C.W. BEADLE HERBARIUM
NE 88775
UNIV. OF NEW ENGLAND AUSTRALIA
100 mm
N.C.W. Beadle Herbarium (NE)
The University of New England
ISOTYPE
Phebalium stellatum I.Telford & J.J.Bruhl
Det : I.R. Telford 6 July 2007
N.C.W. Beadle Herbarium (NE)
University of New England
Armidale NSW 2351 Australia
Notification of change of determination would be appreciated by NE
NE 88775
Rutaceae
Phebalium sp. Cascade
Australia. New South Wales. North Coast:
Wild Cattle Creek State Forest, 100 m along Callitris Rd
from Morora Rd, 2.5 km ENE of Cascade
30° 13' 29" S 152° 48' 47" E 590 m
Broad ridge top. Brown clay loam on metasediments.
Eucalyptus saligna, Lophostemon confertus layered open
forest with Callicoma serratifolia, Trimenia moorei,
Ozothamnus diosmifolius.
Common Tree, 7 m tall; bark with prominent horizontal
lenticels; corolla pale yellow.
Photo, Cuttings, Si gel.
Coll.: I.R. Telford 12938 9 Sep. 2006
& J.J. Bruhl
Det.:
Rep(s): BRI, CANB, HO, K, MEL, MO, NSW, PERTH.
NE Digital Image
14 June 2012
I.R. Telford
12938

Figure 3. Isotype of *Phebalium stellatum* I.Telford & J.J.Bruhl (NE).

Habitat: *Phebalium stellatum* grows in wetter open forest on clay soils derived from metasediments at 600–700 m altitude adjacent to closed forest and with a dense small tree and shrub understorey. Dominant tree species are *Eucalyptus saligna* Sm., *E. microcorys* F.Muell., *E. pilularis* Sm. and *Lophostemon confertus* (R.Br.) Peter G.Wilson & J.T.Waterh. with an understorey including *Callicoma serratifolia* Andrews, *Acacia binervata* DC., *Allocasuarina littoralis* (Salisb.) L.A.S.Johnson, *Schizomeria ovata* D.Don, *Alphitonia excelsa* (A.Cunn. ex Fenzl) Benth., *Archirhodomyrtus beckleri* (F.Muell.) A.J.Scott, *Rubus moluccanus* L. and *Trimenia moorei* (Oliv. ex Benth.) W.R.Philipson.

Conservation status: Six populations have been recorded in the area within 20 km of Cascade. The population at the type locality consists of hundreds of individuals of mixed size classes (pers. obs., 27 May 2019). At this site, the disturbed roadside site suggests regeneration is promoted by opening of the forest canopy. Other populations have not been assessed. Under the IUCN (2017) risk categories, the species must be regarded as "Data Deficient". More detailed consideration to its conservation status will be given in the broader study under way. The species is conserved in Bindari National Park.

Etymology: The epithet is from the Latin *stella* (star), in reference to trichome shape of the indumentum on branchlets and abaxial leaf surfaces, and the starry appearance of the inflorescences.

Notes: Specimens from the Bucketty to Mogo Creek area, Central Coast, New South Wales, possess some stellate trichomes, but in other leaf and seed characters match neither *P. stellatum* nor *P. squamulosum* subsp. *squamulosum s. str.*

Phebalium sylvaticum I.Telford & J.J.Bruhl sp. nov.

Phebalium squamulosum subsp. *squamulosum auct. non* Vent.: Wilson 82 (1970; 2013) *p.p.*, excluding all populations except for North Coast (other than Cascade area) and Gibraltar Range, N.S.W.; Weston & Porteners 258 (1993) *p.p.*, *ibid.*; Weston & Harden 303 (2002) *p.p.*, *ibid.*

***Type*: NEW SOUTH WALES**. Northern Tablelands: Gibraltar Range National Park, 2 km north-east of turn-off to Washpool National Park along Gwydir Highway, *L.M. Copeland 40846*, 6 Sep 2006; holo: NSW; iso: BRI, CANB, K, MEL (MEL2380138), MO, NE (NE88815).

Diagnosis: differs from *P. squamulosum* Vent. *s. str.* in larger, usually narrowly lanceolate leaves (17–)30–70(–80) × (3.5–)5–10 vs 8–34 × 2.5–5.5 mm), seed ornamentation (verruculose with few longitudinal ridges on outer face vs many longitudinal ridges), and the absence of squamulosone from its leaf essential oil.

Shrubs or trees, stems erect to 6 m tall. *Bark* grey-brown, ±smooth roughened slightly by paler lenticels. *Branchlets* densely scaly with rufous lepidote trichomes. *Leaves*: petiole 2–4.5 mm long; lamina narrowly lanceolate to narrowly elliptic, (17–)30–70(–80) mm long, (3.5–)5–10 mm wide, obtuse to acute, margin entire to sinuate, flat to slightly recurved; adaxial surface with midrib impressed, glabrous, glossy green, slightly raised and rounded above the glands; abaxial surface densely silver and silver-rufous lepidote. *Inflorescence* terminal, of up to five 3–6-flowered umbels, the several adjacent upper axils with solitary umbels; peduncle 1.5–4 mm long, silvery lepidote; pedicels 5–10 mm long, silvery lepidote. *Calyx* broadly cup-shaped, c. 1.5 mm long, 2.5–2.8 mm diam.; very shallowly 5-lobed, silvery and rufous lepidote on abaxial surface. *Corolla* of 5 free petals; petals elliptic, 3.5–4.2 mm long, 1.8–2 mm wide, obtuse; adaxial surface glabrous, yellow; abaxial surface densely rufous lepidote with a narrow glabrous margin. *Stamens* 10; filaments filiform, 3.5–6.5 mm long, glabrous; anthers elliptic, 1–1.2 mm long; apical gland globose. *Ovary* subglobose, 1.5–1.8 mm diam., of 5 carpels, densely silvery lepidote; style 4–4.5 mm long, with stellate trichomes or rarely lepidote on lower half; stigma truncate. *Fruit* a capsular schizocarp of up to 5 erect cocci; cocci compressed obovoid, 2.3–3 mm long, 1.8–2.5 mm wide, truncate, silvery lepidote. *Seeds* compressed narrowly obovoid, 2.2–2.7 mm long, 1.3–1.5 mm wide, with a short reflexed apical beak and discontinuous longitudinal ridges appearing more or less warty mainly on the outer face, glossy black. (Figs 1D, 5)

***Specimens examined (selection)*: QUEENSLAND:** Moreton District: Mt Ballow, *C.T. White 11101*, 25 July 1937 (BRI); Durrumlee Peak, Mt Ballow area, McPherson Range, *P.I. Forster PIF7440 & G. Leiper*, 19 Sep. 1990 (BRI, CBG, MEL, NSW, PERTH); Double Peak, Mt Ballow area, *G. Leiper s.n.*, 18 Aug. 1990 (BRI); Mowburra Peak, Mt Barney National Park, *D.A. Halford Q7380*, 10 Sep. 2002 (BRI, MEL). **NEW SOUTH WALES:** North Coast: Unungar State Forest [now Toonumbar National Park], *Jones s.n. AQ 152704*, Oct 1947 (BRI); Toonumbar State Forest [now

Figure 4. *Phebalium stellatum*; A: flowering tree and habitat at Wild Cattle Creek State Forest, N.S.W. (type locality); B: inflorescences after rain; scale bar=10 mm.

N.C.W. BEADLE HERBARIUM
NE 88815
UNIV. OF NEW ENGLAND AUSTRALIA
100 mm
N.C.W. Beadle Herbarium (NE)
The University of New England
ISOTYPE
Phebalium sylvaticum I.Telford & J.J.Bruhl
Det: I.T. Telford 6 July 2007
N.C.W. Beadle Herbarium (NE)
The University of New England
Phebalium sp. Mt Ballow (C.T. White 11101) P.I. Forster
Det. I.T. Telford Oct. 2006
N.C.W. Beadle Herbarium (NE)
University of New England
Armidale NSW 2351 Australia
Notification of change of determination would be appreciated by NE
NE 88815
Rutaceae
Phebalium squamulosum Vent.
Australia. New South Wales. Northern Tablelands:
Gibraltar Range National Park, 2 km NE of turn-off to
Washpool National Park along Gwydir Highway
29° 28' 40" S 152° 20' 50" E 1030 m
Steep slope; NW aspect. Loamy soil over metasediments.
Disturbed rain forest with Callicoma serratifolia, Acacia
melanoxylon, Cyathea australis and Prostanthera caerulea
s.lat.
Common, localised. Erect shrub 2.5 m tall.
Coll.: L.M. Copeland 4084 6 Sep. 2006
Det.:
Rep(s): BRI, CANB, K, MEL, MO, NSW.
NE Digital Image
14 June 2012

Figure 5. Isotype of *Phebalium sylvaticum* I.Telford & J.J.Bruhl (NE).

Toonumbar National Park], W of Kyogle, *J.B. Williams s.n.*, 30 Aug. 1977 (BRI, CANB *n.v.*, MEL *n.v.*, NE, NSW *n.v.*); Gibraltar Range, c. 67 km NE of Glen Innes, *E.K. Winterhalder 629 & J.B. Williams*, Oct. 1961 (NE, NSW); Summit Mountain, Gibraltar Range National Park, *A.R. Bean 16846*, 8 Sep. 2000 (BRI); Clouds Creek, *H. Beckler*, [1859–1860] (MEL, image seen).

Distribution*: Phebalium sylvaticum* has been collected from four disjunct areas: the Mount Ballow area, McPherson Range, just north of the Queensland–New South Wales border north-east of Woodenbong and the Richmond Range south of Woodenbong, New South Wales, in the South East Queensland Bioregion, and the Gibraltar Range, north-east of Glen Innes, and Clouds Creek, New South Wales in the New South Wales North Coast Bioregion.

Phenology*:* The species flowers August–October; fruits December.

Habitat: *Phebalium sylvaticum* grows in closed forest, wetter open forest or shrubland on clay loams usually derived from basalt or other volcanics at 800–1200 m altitude. Most sites are dominated by *Eucalyptus saligna* Sm., *E. campanulata* R.T.Baker & H.G.Sm. and *E. obliqua* L'Her., usually adjacent to closed forest and with rain forest elements including *Acacia melanoxylon* R.Br. and *Callicoma serratifolia* Andrews in the understorey. Populations on the Gibraltar Range occur on the margins of *Ceratopetalum apetalum* D.Don and *Doryphora sassafras* Endl. closed forests on soils derived from metasediments or basalt. In the Mount Ballow area, the species is recorded in closed (simple microphyll moss) forest with *Nothofagus moorei* (F.Muell.) Krasser dominant on soils derived from trachyte, while on the nearby Double Peak it is in a tall shrubland with *Pomaderris argyrophylla* N.A.Wakef. and *Leptospermum*.

***Conservation status*:** Six extant populations of this species are known, but numbers of mature plants per population have not been assessed. *Phebalium sylvaticum* must be regarded as "Not Evaluated" following the IUCN (2017) guidelines. More detailed consideration to its conservation status will be given in the broader study under way. The species is conserved in Mount Barney National Park, Queensland, and Toonumbar and Gibraltar Range National Parks, New South Wales.

Etymology: The epithet is from the Latin *sylva* (forest), in reference to the wet forest habitats of the species.

***Notes*:** the first collection of *Phebalium sylvaticum*, by Hermann Beckler in 1859–1860, was sterile and subsequently misidentified as *Phebalium billardieri* A.Juss., which is now a synonym of *Nematolepis squamea* (Labill.) Paul G.Wilson (Bentham 1863: 344), and also misidentified as *Phebalium squamulosum* var. *longifolium* (S.T.Blake) Paul G.Wilson, which is now treated as *Phebalium longifolium* S.T.Blake, a north Queensland endemic.

Vegetatively, *P. sylvaticum* may be superficially similar to *P. distans* and *P. longifolium*. The leaves of *P. sylvaticum* are generally shorter and wider than leaves of either *P. distans* (of southeastern Queensland) or *P. longifolium* (of northeastern Queensland); distinctly wider than in *P. distans*. Leaves of one specimen of *P. sylvaticum*, *L. Crooke s.n.* (NE 44919) are atypically smaller than other specimens. The lepidote trichomes appear to differ across these species, but further study is required to characterise the variation. Seed morphology appears to be diagnostic for species in *Phebalium* (e.g., Figure 1). In *P. longifolium*, seeds are considerably longer than in *P. sylvalticum*. Seed ornamentation differs with *P. longifolium* having fine longitudinal ridges, in contrast to the coarse broken ridges of *P. sylvaticum*.

Acknowledgements

Funding was provided to IRT by ABRS National Taxonomy Research Grant (Non-salaried Researchers) for part of this project. Thanks to Directors at BRI and NSW for the loan of material; to Pina Milne and Wayne Gebert for the images of MEL specimens; to Alex Floyd for use of facilities at CFSHB; and to the Office of Environment NSW, National Parks and Wildlife Service NSW and State

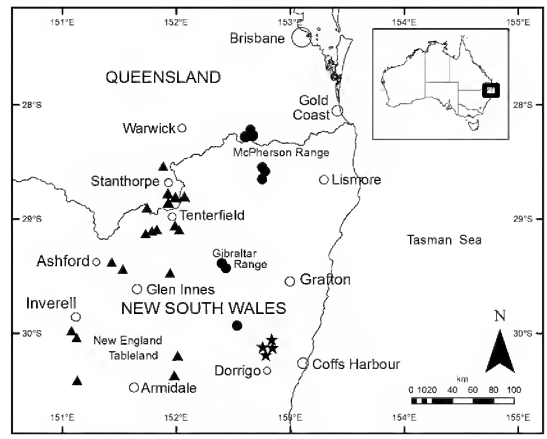

Figure 6. Distributions of (▲) *P. graniticola*; (★) *P. stellatum*; (●) *P. sylvaticum.*

Forests NSW for permission to collect in reserves under their administration. Thanks also go to Rose Andrew, Sangay Dema, Helen Kennedy (all UNE) for assistance with fieldwork. We thank Marco Duretto and Matthew Renner (NSW) for extensive comments on an earlier draft and an annoymous referee for further comments.

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Muelleria

38: 17–25

Published online in advance of the print edition, 20 August 2019

ROYAL BOTANIC GARDENS VICTORIA

Agrostis semibarbata: an old name for *Lachnagrostis punicea* (Poaceae)

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Abstract

Agrostis semibarbata Trin. is found to be synonymous with *Lachnagrostis punicea* subsp. *punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs rather than with *L. aemula* (R.Br.) Trin., and the new combination, *L. semibarbata* (Trin.) A.J.Br. is made. As a result of morphological re-examination, *L. punicea* subsp. *filifolia* (Vickery) S.W.L.Jacobs is reduced to varietal status in the new combination *L. semibarbata* var. *filifolia* (Vickery) A.J.Br.

Keywords: Taxonomy, grasses, Van Diemen's Land, R.C. Gunn, J.D. Hooker, C.B. von Trinius

Introduction

Brown and Walsh (2000) published the names *Agrostis punicea* A.J.Br. & N.G.Walsh var. *punicea nom. et stat. nov.* and *A. punicea* var. *filifolia* (Vickery) A.J.Br. & N.G.Walsh *comb. nov.* for *A. aemula* var. *setifolia* (Hook.f.) Vickery (syn. *A. billardierei* var. *setifolia* Hook.f.) and *A. billardierei* var. *filifolia* Vickery, respectively. Jacobs (2002, 2004) transferred these taxa to *Lachnagrostis* Trin. as *L. punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs subsp. *punicea* and *L. punicea* subsp. *filifolia* (Vickery) S.W.L.Jacobs, respectively. In preparing taxonomic papers on *Lachnagrostis*, some historic anomalies were uncovered in relation to *L. punicea* and *Agrostis semibarbata* Trin. These anomalies are corrected here, while the statuses of the associated subspecies are reassessed.

Materials and Methods

Type specimens (LE images and K loans) and original descriptions of *Agrostis semibarbata*, *A. billardierei* var. *setifolia* and *A. aemula* var. *setifolia* were assessed. Specimens at MEL (herbarium codes follow Thiers 2019+) of both subspecies of *Lachnagrostis punicea*, collected from South Australia and Tasmania, and specimens collected from Victoria in the last two decades were assessed for their spikelet, lemma body, lemma setae, lemma awn, palea body, palea setae and anther lengths, using the same technique as that reported by Brown and Walsh (2000). The current measurement set (from approximately 50 populations) was added to

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

those previously reported by Brown and Walsh (2000) for Victorian collections up to 1999, and a reappraisal of the character differences between the subspecies was made. For the pre-2000 Victorian specimens (40 of subsp. *punicea* from 18 sites and 52 of subsp. *filifolia* from 17 sites), means of duplicates were calculated before ranges and standard deviations were determined for the whole data set. Significant differences were assessed by calculating and comparing the twice standard errors (i.e., 95% confidence limits) for each mean.

Results and Discussion

Identifying *Agrostis semibarbata* Trin.

Trinius (1841) described a new species, *Agrostis semibarbata*, based on material from Tasmania. In July 1939, C.E. Hubbard marked two of four specimens of *Gunn 592/1* (Penquite, Tasmania, 9.xii.1844; K000838253–K000838254) with the note "These specimens agree well with the type of *Agrostis semibarbata* Trin (Hb. Leningrad)", and one of six specimens of *Gunn 1446* (New Norfolk, Tasmania, 15.xi.1840, K000838251–K000838252) with "This specimen agrees well with the type of *Agrostis semibarbata* Trin." As part of the 1994 Smithsonian Institution and Komarov Botanical Institute Gramineae Types Project, Soreng *et al.* (1996) referred to a sheet at LE as the 'holotype' ("HT") of *A. semibarbata* as "Trin. 1655.01: HT-frag. & fig." Consequently, Tropicos (2017) currently reports the 'holotype' of *A. semibarbata* as "V. D. L. G (LE–TRIN–1655.01 (fragm. & fig.))" (originally as "V. D. I. C")[1], the protologue "Island Van Diemen Australia", and collector as "Hooker".[2] Hubbard annotated the LE sheet with "= *Agrostis aemula* R.Br. var. *setifolia* (Hook.f.) Vickery m.s. 7/1939". Vickery annotated the Penquite and New Norfolk collections at K (K000838253–K000838254 and K000838251–K000838252) as "*Agrostis aemula* var. *setifolia* (Hook.f)" on 12th August 1938, a year before Hubbard's matching of them to *A. semibarbata*. Earlier annotations of unknown authorship on both collections include "*D. Billardieri b*", "*Deyeuxia billardieri* Kunth." and "var. *setifolia*" Hook.f."

Hooker (1860), in his *Flora Tasmaniae*, briefly described *Agrostis billardierei* var. *ß setifolia* Hook.f. on account of its "*foliis anguste setaceis*" [i.e.,narrow bristly leaves] and "*arista prope basin paleae inserta*" [i.e.,lemma awn inserted near the base], but did not cite any specimens. He cited *Gunn 592* and *Gunn 1007* under *A. billardierei*, and *Gunn 592 p.p.*, *Gunn 1006* and *Gunn 1447* for *A. aemula*, but does not mention *Gunn 1446* at all. Apart from the *Gunn 592/1* Penquite collection, there are three other collections labelled as *Gunn 592* at K: 'New Norfolk', 11.xii.1840 (K000607848), 'Macquarie Plains', 19.xi.1842 (K000342384) and 'side of the Western Mountains', 16.i.1845 (K000607846–K000607847). The taxon annotation on two of these sheets (K000607848, K000607846–K000607847) is '*Deyeuxia forsteri* Kunth', which is the same as on the K material Hooker (1860) likely used to describe *A. aemula*, namely: *Gunn 1006*, Tasmania, 11.xii.1837 (K000607849); *Gunn 1447*, base of Mt Wellington, 1.iii.1839 (K000607839); *Gunn 1447*, New Norfolk, xii.1839 (K000607838); *Gunn 1447*, New Norfolk xi.1840 (K000607845) and *Gunn 1447*, South Esk, Launceston, 17.xii.1844 (K000607844). The older name of *Deyeuxia forsteri* (Roem. & Schult.) Kunth. *nom. illeg.* was used by Hooker (1853) in his *Flora Novae-Zelandiae*, under which he placed *Agrostis forsteri* Roem. & Schult. *nom illeg, nom. superfl.*, *A. aemula* R.Br., *A. retrofracta* (as "*Schrad. in Herb. Hook.*")[3], and *Avena filiformis* G.Forst. and *Lachnagrostis filiformis* (G.Forst.) Trin. as synonyms. As *Gunn 1007* (K000342399), with its broad leaves, is a typical example of *A. billardierei* R.Br. var. *billardierei* (syn. *L. billardierei* (R.Br.) Trin. subsp. *billardierei*), Hooker may have had *Gunn 592/1* (Penquite) in mind as his representation of *A. billardierei* var. *setifolia*.

Hooker (1860) described *Agrostis billardierei* var. *billardierei* as having "Lower palea [i.e. lemma] silky at the base [...] awn inserted at the middle of the palea", whereas *A. aemula* is described as "Lower palea very silky all over [...] awn inserted at the middle." It is not certain whether he was referring to the callus with his "lower palea silky at the base" or to the lower back

1 Current examination of an image of the type sheet for *Agrostis semibarbata* has concluded that "V.D.I.C." is a misinterpretation of the handwriting "V.D.L.6" (i.e. Van Diemen's Land No. 6) on the specimen label.

2 Hooker's name does not appear on the lectotype sheet but derives from Trinius' publication of the taxon (Trinius 1841). This does not mean that Hooker collected the specimen himself but most likely that it was collected for him and subsequently forwarded to Europe. William Hooker never visited Australia and although his son Joseph collected in Tasmania, this was not until August 1840. It is therefore very unlikely, even if Joseph Hooker had made a collection of *A. semibarbata*, that it would have reached Trinius in time for his publication.

3 Brown (2019) notes that "*Schrad. in Herb. Hook.*" refers to a collection by Schrader, not an author citation for the name.

of the lemma. Brown (1810), when first describing *A. billardierei*, noted "*valvula exteriore perianthii* [i.e. lemma] *glabra*" as opposed to "*pubescenti*" as given for *A. aemula*, and it could be assumed that Hooker would have followed his lead. Based on this assumption, and given that Hooker (1860) does not mention the hairiness of the lemma when describing *A. billardierei* var. *setifolia*, the reader would assume that his new variety also had a glabrous lemma, apart from the callus. However, examination of both *Gunn 592/1* (Penquite) and *Gunn 1446* (New Norfolk) shows that all specimens on these sheets, except for one (top left of *1446*)[4], have hairy lemmas and conform to *Lachnagrostis punicea* subsp. *punicea* (syn. *A. aemula* var. *setifolia*). This being the case, Hooker's "lower palea silky at the base" seems to refer to the lower part of the lemma after all. Regardless of the character of the lemma indumentum, Hooker probably assigned var. *setifolia* to *A. billardierei* on the basis of its larger spikelets, as compared to *A. aemula*. In reference to *A. billardierei*, Hooker notes "Spikelets larger than in the allied species, 1/4–1/3 inch [i.e. 6.4–8.4 mm] long." Hooker's "allied species" were *A. aemula* R.Br. and *A. montana* R.Br. *nom. illeg. non* Krocker (syn. *Deyeuxia monticola* (Roem. & Schult.) Vickery), which were regarded by him as conspecific. For *A. aemula*, Hooker (1860) notes "Spikelets 1/8–1/6 inch [i.e. 3.2–4.3 mm] long." Spikelet lengths for *L. punicea* range from 4.5–7.0 mm (Brown and Walsh 2000) and are therefore more akin to Hooker's spikelet sizes for *L. billardierei* than for *L. aemula*. However, despite Trinius (1841) describing the spikelets of *A. semibarbata* as "*Spiculis 3 – linealibus*" [i.e. 3 lines = 6.33 mm length], Hooker (1860) regarded Trinius' taxon as synonymous with *A. aemula* (albeit with a question mark), rather than with *A. billardierei*.

In formally describing *Agrostis aemula* var. *setifolia*, Vickery (1941) designated *Gunn 1446* (K) as the 'Type' and cited *Gunn 592* (Penquite)[5] as an additional specimen under her concept of the taxon. Like Hooker, she included the other *Gunn 592* collections at K as examples of *A. aemula* var. *aemula* but assigned *Gunn 1447* (base of Mt Wellington) and *Gunn 1006* to *A. avenacea* Gmel. (syn. *Lachnagrostis filiformis* (G.Forst) Trin.). Hooker's concept of *A. aemula* (or *Deyeuxia forsteri*) was that it also included the taxon currently known as *L. filiformis*. Also, like Hooker, Vickery (1941) referred *A. semibarbata* to *A. aemula* R.Br. var. *aemula*. Even though she noted of *A. semibarbata*, "from the description this appears to represent a form with large spikelets, lemma with 2 long teeth, and anthers large and linear", she seemingly overlooked its striking resemblance to her *A. aemula* var. *setifolia*, including its "*Foliis compressis*" [i.e. compressed leaves], "*Valvula inferior* [...] *inferne circiter tertiam partem pilosa*" [i.e. Lemma pilose below about third part] and the "*Arista infra medium valvulae proveniens*" [i.e. Awn below middle of lemma] descriptions by Trinius (1841).

Although a physical assessment of LE TRIN–1655.01 could not be made due to restrictions on loans, an image of the sheet (Figure 1) and high-resolution images of a few open spikelets were made available by LE for examination. These images show the narrow leaves, long pedicels and large spikelets diagnostic for *Lachnagrostis punicea*. A sketch of the spikelet and floret, probably by Trinius, is attached to the sheet and allows an assessment of character sizes to be made. The upper glume is noted as "*3 lin. longa*" and therefore corresponds to the Trinius (1841) description. The upper glume is calculated to be 7.6 mm long, if taken as the Russian 'liniya' (r: 1 line = 2.54 mm), or as 6.3 mm if taken as the standard botanical (or English) line (b: 1 line = 2.12 mm). The remainder of the sketch can be proportioned accordingly and provides lengths of 8.5 (r) or 7.0 (b) mm for the lower glume, 5.7 (r) or 4.8 (b) mm for the total lemma, 2.0 (r) or 1.7 (b) mm for the lemma setae and 3.6 (r) or 3.0 (b) mm for the total palea. Brown and Walsh (2000) describe the lower glume length as 4.5–7 mm, the total lemma length as 3–5.5 mm, the lemma setae as 0.5–1.5 mm and the total palea length as 2.5–4.5 mm. This comparison suggests that Trinius used the standard botanical line, rather than the Russian line, for his measurements. In addition to the sketch of the spikelet, separate sketches were made of the floret, lemma back, lemma apex, palea, rachilla extension, lodicles, ovary and anther (Figure 1). It is difficult to be certain of the scales at which some of these flower parts were drawn, but comparisons between features

4 The odd specimen out is *L. punicea* subsp. *filifolia* (Vickery) S.W.L.Jacobs (syn. *Agrostis billardierei* var. *filifolia* Vickery): a more mature specimen than its companions with minutely scabrid, but distinctly hairless, lemmas.

5 Both Hooker (1860) and Vickery (1941), when citing the Penquite collection, only refer to it as *Gunn 592*, whereas the collection label states *Gunn 592/1*. This is likely to be a modification made by Hooker to Gunn's original collection number, in recognition of its morphological distinction from other Gunn collections bearing the same number.

common among the sketches suggest that, if using the standard botanical line, anther length is either 1.4 mm or 2.0 mm (depending on the scale) and palea setae points are 0.6 mm (i.e., 20% of total palea length) and within the Brown and Walsh (2000) reported ranges of 0.8–2.1 and 0.3–1.2 mm, respectively. However, the lemma awn attachment is higher, at 26–28% from the base, than is typical (10–20%). The high-resolution spikelet images (not shown) indicate the total lemma length to be approx. 5.8 mm long, attachment of the lemma awn at approx. 10% of the lemma length from its base, setae points at the apices of the lemma and palea to be approx. 2.4 mm and 0.6–1.0 mm, respectively, and anthers to be approx. 1.9 mm long. All of these observations and calculations are indicative of the specimen being *L. punicea*.

With the confirmation that Hubbard was correct in determining *Gunn 592/1* and *Gunn 1446* to be the same taxon as LE TRIN–1655.01 it is clear that, along with Hooker (1860) and Vickery (1941), all treatments of *Agrostis* or *Lachnagrostis* since (Ross 1989, Morris 1994, Jacobs 2001, Quottrocchi 2006, Jacobs and Brown 2009, CHAH 2015, Tropicos 2017) have incorrectly treated *A. semibarbata* Trin. as a synonym of *A. aemula* R.Br. or *L. aemula* (R.Br.) Trin. Instead, not only should *A. semibarbata* be regarded as a synonym of *L. punicea*, the latter is also the correct specific epithet for the taxon.

Identifying the original collection

The exact provenance of LE TRIN–1655.01 is unknown. The hand-written label states "V.D.L.6" [Van Diemen's Land No.6], with no collecting date, specific collection location or collector's name. Hooker's name does not appear on the sheet, only in Trinius (1841). As the specimen consists of only one emerging panicle, its flag leaf and a length of culm with a second leaf (Figure 1), it appears to have been removed from a larger collection. The "V.D.L.6" on the LE specimen sheet appears to be a collection number applied to a duplicate taken from the herbarium of Joseph Dalton Hooker's (1817–1911) father, William Jackson Hooker (1785–1865). Two sheets of *Lachnagrostis semibarbata* at K are marked with either "V.D.L.10" (K000913405–K000913406) or "V.D.L.12" (K000838424), and a further sheet at LE is marked "V.D.L.7 Hooker" (LE TRIN–1584.06), suggesting that a series of duplicates were prepared by Hooker for Trinius.

William Hooker, future Director of Kew Gardens, but then at Glasgow University, was an active recipient of Tasmanian plant specimens during this period, utilising colonial collectors, such as Thomas Scott (1800–1855), Robert Lawrence (1807–1833) and Ronald Campbell Gunn (1808–1881). Scott forwarded some seed and a few plants to Hooker but no known grass collections. Lawrence was actively sending Hooker seeds from 1830 and dried plant specimens from 1831 (Burns and Skemp 1961) until his early death. Gunn was introduced to Hooker by Lawrence via letter and became his successor in supplying plant specimens to Great Britain from 1832–1849 and, as such, is the most likely collector of the material from which LE TRIN–1655.01 was taken. However, the K sheet marked "V.D.L.12" is a Lawrence collection, while the "V.D.L.10" sheet was collected by Gunn. A further contender for the original collection of *Agrostis semibarbata* is James Backhouse, a Quaker from England who visited Tasmania and New South Wales as a missionary to settlers and convicts during 1832–1838, but who consequently took an active interest in the flora. Although it is not known if Backhouse collected any grasses, some of his earlier plant collections from Tasmania were forwarded by Gunn to Hooker (Burns and Skemp 1961).

Trinius' publication of *Agrostis semibarbata*, dated 5th February 1841, precedes the collection of *Gunn 592/1* by almost three years, and although publication coincides with the collection date of *Gunn 1446* on 15th November 1840, it is highly unlikely that this collection could have reached Hooker in Glasgow and been subsequently processed and forwarded to St Petersburg in time for its inclusion in Trinius' study. Gunn's earliest known collection of *592* dates from 1833 (Gunn c.1830–1850). Also, in an 1835 consignment to Hooker, sent as Box 2, at least one collection was labelled *Gunn 592* (Burns and Skemp 1961). The current whereabouts of both these collections are unknown but either could be the source of LE TRIN–1655.01. As *Lachnagrostis punicea* (syn. *A. semibarbata*) has been found growing with *L. aemula* (Brown and James 1998), the specimen at LE may have been part of a mixed gathering collected with *Gunn 592* and separated out by either Hooker or Trinius.

Infraspecific classification

Brown and Walsh (2000) recognised that *Agrostis aemula* var. *setifolia* Vickery and *A. billardierei* var. *filifolia* Vickery were varieties of the same species viz. *A. punicea*. Jacobs subsequently (2001, 2002, 2004) placed 15 Australian species of *Agrostis* into *Lachnagrostis*, including *A. punicea*, but raised the varieties recognised by Brown and Walsh to subspecies. Brown and Walsh (2000) showed that, apart from its hairy lemmas, *A. aemula* var. *setifolia* only differed statistically from *A. billardierei* var. *filifolia* in its slightly longer lemmas, lemma setae and awns. However, the range in these floret character lengths show considerable overlap. The addition of recent measurements of spikelet characters to the original Brown and Walsh (2000) data set, with recalculation of means and standard deviations, does not support the statistical differences that were previously observed, even though the spikelets, lemma setae and awns tend to be longer in subsp. *punicea* (Table 1). Therefore, only the difference in lemma hairiness between the two subspecies remains. Brown (2012) noted that as there are no intermediates between the villous lemmas of subsp. *punicea* and the glabrous lemmas of subsp. *filifolia*, it is probable that a single gene is responsible for the distinction. Both subspecies occur in similar ecological niches and have been found in mixed populations (Tasmania: New Norfolk – type sheet at K; Victoria: Buckley Swamp; Lake Repose, South Bulart, Moyne Falls, Penshurst, Hexham; South Australia: East Avenue), though these represent only 8% of known sites for the species. As the numbers of pure populations of both subspecies are similar, it seems that neither has dominance and that their largely allopatric distribution is the result of stochastic genetic drift.

Hamilton and Reichard (1992) note that, in practice, there is little difference between subspecies and variety, with European botanists tending to favour the former and Americans favouring the latter. Both infraspecific levels usually require additional differentiation (e.g. geographic, ecological, phylogenetic) beyond morphological distinction, to warrant recognition. Earlier, Clausen (1941) argued that use of the term 'variety' in taxonomic treatments not only breaks with the Linnaean tradition of describing "mere trivial genetic variations", but has become confused through its multifaceted and inconsistent use in horticulture.

Walsh (2015) has also noted the lack of precision in defining the difference between subspecies and variety but suggests that the rank of subspecies has more recently, at least in Australia, been reserved for entities within a species that display a more or less geographical or ecological separation, as opposed to variety for "weakly distinguishable entities with a greater

Table 1. Minimum, maximum and mean length (mm), standard deviation (SD) and twice standard error (2SE = 95% conf. limits) for spikelet characters across specimens of *Lachnagrostis punicea* subspp. *punicea* and *filifolia*, and significant differences in characters between them.

Taxon	Lower glume	Lemma body	Lemma setae	Lemma awn	Palea body	Palea setae	Anther
***Lachnagrostis punicea* subsp. *punicea* (42 collections)**							
min	4.8	2.6	0.6	7.0	2.0	0.3	0.8
max	9.7	4.7	1.8	14.3	3.8	1.2	1.8
Mean	6.18	3.37	1.08	10.07	3.02	0.60	1.33
SD	0.93	0.48	0.29	1.33	0.40	0.18	0.23
2SE	0.28	0.14	0.09	0.40	0.12	0.05	0.07
***Lachnagrostis punicea* subsp. *filifolia* (35 collections)**							
min	4.0	2.2	0.4	5.7	2.0	0.3	0.8
max	7.7	4.4	1.7	13.7	4.3	1.2	1.9
Mean	5.77	3.26	0.94	9.21	2.89	0.57	1.25
SD	0.83	0.46	0.38	1.60	0.49	0.18	0.24
2SE	0.28	0.15	0.13	0.53	0.16	0.06	0.08
sign. diff.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

n.s. = no significant difference at 95% confidence limits

degree of sympatry." Under these criteria, infraspecific classification for *Lachnagrostis punicea* would not support the use of subspecies. Within *Lachnagrostis*, Brown (2006, 2015a, 2015b) has utilised subspecies for morphologically distinct entities within *L. nesomytica* A.J.Br., *L. rudis* (Roem. & Schult.) Trin. and *L. adamsonii* (Vickery) S.W.L.Jacobs, but these, unlike *L. punicea*, also have distinct ecological niches or, at least, geographical separation.

Use of the term 'forma' in non-horticultural taxonomy dates from the mid 1840s and is usually employed to denote a minor genetic difference without extramorphological integrity. By this definition, it would seem more consistent to reduce the subspecies of *Lachnagrostis punicea* to formae. Amongst grasses, some precedent for this approach has been established in the *Flora of Australia*, where Weiller (2009) accepts *Vulpia megalura* (Nutt.) Rydb. as a form of *V. myuros* (L.) C.C.Gmel. as *V. myuros* f. *megalura* (Nutt.) Stace & R.Cotton, based solely on the conspicuous presence of marginal cilia on its upper lemmas. Another example is afforded by the acceptance of *Lolium arvense* With. as a form of *L. temulentum* L., *L. temulentum* f. *arvense* (With.) Junge, by Weiller *et al.* (2009), based on its lemma being unawned or having a short, weak, flexuose awn, versus a lemma with a distinct, long and straight awn in the typical form. In both these examples of naturalised species, geographic and ecological ranges are similar for the two forms, which are often found coexisting in the same population[6].

Nevertheless, and despite the above argument, it seems most appropriate to avoid the forma level of classification for a number of reasons. Firstly, very few contemporary treatments employ formae. Within a world-wide survey of 8043 species (Hamilton and Reichard 1992), only 4.0% of the 1020 species that were subdivided use the rank of forma (i.e., 0.32% of species overall). An examination of accepted taxa recorded in the Australian Plant Census (CHAH 2015) shows only 57 taxa at forma level, accounting for less than 0.2% of all currently accepted names (excluding autonyms). Formae were confined to 34 species in 26 genera. Of these, seven species are naturalised, 13 are rainforest shrubs or trees, three are vines and three are geographic forms awaiting more conventional names. Secondly, the use of forma may imply phenotypic difference in response to environmental factors, rather than a genetic cause. Hamilton and Reichard (1992) note that authors utilising formae usually did so in the traditional sense of denoting distinct phenotypes which have no significant persistent populations. Thirdly, Stuessy (1990) regarded formae as plants having unusual morphological features growing near plants with more typical features, with the implication that the unusual individuals are infrequent and of sporadic occurrence. This is not the case for *Lachnagrostis punicea*. Stuessy (1990) recommended that the rank of forma should only be used for cultivated plants, or in breeding programs where 'forms' of wild plants have the potential for commercialisation.

It is therefore most consistent to reduce the subspecies of *Lachnagrostis punicea* to varieties under *L. semibarbata*. This also has the effect of returning to the original infraspecific concept of Brown and Walsh (2000) for these taxa.

Currently, *Lachnagrostis punicea* subsp. *punicea* and *L. punicea* subsp. *filifolia* are both listed as rare in South Australia (National Parks and Wildlife Act 1972, Version 1.7.2015), Victoria (Department of Environment and Primary Industry Advisory List, 2014) and Tasmania (Department of Primary Industries, Parks, Water and Environment Threatened Species Protection Act 1995). Both taxa are also listed as threatened under the Victorian Flora and Fauna Guarantee (FFG) Act 1988 but neither are listed under the National Environment Protection and Biodiversity Conservation (EPBC) Act 1999. As Walsh (2015) has pointed out, varieties are not eligible to be listed under section 178 of the EPBC Act, whereas subspecies are. Nevertheless, reducing subspecies status to varietal status in accordance with the biological arguments presented above, does not diminish the importance of protecting both taxa from a conservation point of view. As these varieties are not commonly found in sympatry, there remains a real potential for speciation events to occur over time.

6 In the examples of formae provided by *Vulpia myuros* and *Lolium temulentum*, infraspecific naming in both species has a varied history, with *V. myuros* f. *megalura* (Nutt.) Stace & R.Cotton (1976) also treated at varietal or subspecific rank as *V. myuros* var. *megalura* (Nutt.) Auquier (1977) and *V. myuros* subsp. *megalura* (Nutt.) Soják (1979), and *L. temulentum* var. *arvense* (With.) Lilj. (1816) also treated at formae and subspecific rank as *L. temulentum* f. *arvense* (With.) Junge (1913) and *L. temulentum* subsp. *arvense* (With.) Tzvelev (1971).

Taxonomy

Lachnagrostis semibarbata (Trin.) A.J.Br. comb. nov.

Agrostis semibarbata Trin., *Agrostidea, II*, Callo Rotunda, (Agrostea), 132 (1841).

***Type**: s. loc., s. dat., leg. ign.* V.D.L.6 (lecto, here designated as holotype: LE TRIN–1655.01 (fragm. & Figure)).

Agrostis billardierei var. *setifolia* Hook.f., *Fl. Tasman.*, 3(2): 115 (1860); *Agrostis aemula* var. *setifolia* (Hook.f.) Vickery, *Contr. New South Wales Natl. Herb.* 1: 116 (1941); *Agrostis punicea* A.J.Br. & N.G.Walsh var. *punicea*, *Muelleria*, 14: 84–85 (2000); *Lachnagrostis punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs subsp. *punicea*, *Telopea*, 9(4): 837 (2001).

Type: **TASMANIA.** New Norfolk, 15.xi.1840, *M. Ballantine for R.C. Gunn 1446* (lecto: designated by J.W.Vickery, *Contr. New South Wales Natl. Herb.* 1: 116 (1941)), K000838251! and K000838252!, a single gathering mounted as one preparation with two accession numbers; isolecto: HO35753!).

Notes: Soreng *et al.* (1996) referred to a sheet at LE as the 'holotype' of *A. semibarbata*. However, as this work (*Catalogue of the C. B. Trinius Herbarium (LE)*, 2nd edn) is not effectively published under ICN Articles 29 and 30 (Shenzhen Code, 2018; R. Soreng, pers. comm. 2019), this does not constitute effective lectotypification by Soreng *et al.* in accordance with ICN Art. 7.11 (Shenzhen Code, 2018), and the name is lectotypified here.

Vickery (1941) cites the type of the name *Agrostis billardierei* var. *setifolia* Hook.f. as 'Tasmania: New Norfolk, Gunn, No. 1446, 15.11.1849 (Type, K.)'. Jacobs and Brown (2009) noted that *Gunn 1446* was collected by Ballantine, which is the name on the isotype at HO in accordance with the initials '*MB*' on the original Gunn label.

Hooker (1860) did not specify a type for *Agrostis billardierei* var. *setifolia* Hook.f., but cited both *Gunn 592* and *Gunn 1007* under his concept of *A. billardierei*. Vickery, in using *A. billardierei* var. *setifolia* Hook.f. as the basionym for *A. aemula* var. *setifolia* (Hook.f.) Vickery, cited *Gunn 1446* (New Norfolk) as the type, even though Hooker (1860) made no reference to *Gunn 1446* in the protologue. However, as both sheets at K bear the inscription '*b* ' as a probable identification by Hooker to Hooker's (1860) "*Agrostis billardierei* var. *ß setifolia*", both specimens can be considered original material under Article 9.4a (Shenzhen Code 2018).

Lachnagrostis semibarbata var. *filifolia* (Vickery) A.J.Br. comb. et. stat. nov.

Agrostis billardierei var. *filifolia* Vickery *Contr. New South Wales Natl Herb.* 1, 110 (1941). *Agrostis punicea* var. *filifolia* (Vickery) A.J.Br. & N.G.Walsh *Muelleria*, 14, 85–86 (2000). *Lachnagrostis punicea* subsp. *filifolia* (Vickery) S.W.L.Jacobs *Telopea* 10(4), 840 (2004).

***Type citation**:* "Hawkesdale, H. B. Williamson, No. K. 410, 12.1901 (Type K., S.)."

Type: **VICTORIA.** Hawkesdale, xii.1901, *H.B. Williamson K.410* (lecto: designated by A.J.Brown & N.G.Walsh, *Muelleria* 14: 85 (2000): K000838266!; isolecto: NSW504501!).

Notes: Vickery (1941) cites *Williamson K410* as the type of the name *Agrostis billardierei* var. *filifolia* Vickery, and lists syntype material at K and S. Brown & Walsh (2000) cite the type of the name *Agrostis billardierei* var. *filifolia* Vickery as "Victoria, Hawkesdale, Dec. 1901, *Williamson* (holotype K)", and this is here treated as effective lectotypification by Brown and Walsh in accordance with ICN Art. 7.11 (Shenzhen Code, 2018). As Brown and Walsh's citation meets the relevant requirements of ICN Art. 7.11, their use of the term 'holotype' is correctable under ICN Art. 9.10. Additional material in S, cited by Vickery, has not been seen by the present author. A further specimen, MEL2022935A (Hawkesdale, Victoria, xi.1903, *H.B. Williamson s.n*) was probably collected from the type locality, two years later. The sheet also contains MEL2022935B—inflorescence fragments of *Lachnagrostis billardierei* Trin. subsp. *billardierei*.

Acknowledgements

Many thanks are due to the staff of K for the loan of specimens, to Robert Soreng of the National Museum of Natural History, Smithsonian Institution, for information relating to the type of *Agrostis semibarbata* at LE, and to Dr Irina Illarionova and Dr Vladimir Dorofeyev of the Komarov Botanical Institute, Saint Petersburg, for the excellent images of the type. Thanks also to MEL staff: Pina Milne and Catherine Gallagher for assistance in corresponding with overseas herbaria, and to Neville Walsh and Tom May for helpful discussions concerning taxon ranking and nomenclature. Special

Figure 1. Holotype of *Agrostis semibarbata* Trin. (LE–TRIN–1655.01). Image kindly provided by the Komorov Botanical Institute, Saint Petersburg.

thanks to Brendan Lepschi of the Centre for Australian National Biodiversity Research and Australian National Herbarium, CSIRO, Canberra, for expert advice on nomenclatural presentation and lectotypification.

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Muelleria

38: 27–69

Published online in advance of the print edition, 20 August 2019

ROYAL BOTANIC GARDENS VICTORIA

An annotated census of the lesser-known naturalised plants of Tasmania

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Introduction

Documenting and maintaining the vouchered evidence of the naturalised flora of a region is an important role of the modern herbarium. Within Australia, the naturalised flora has steadily increased and makes up a significant proportion of the total. For example, in terms of the number of taxa at specific or subspecific rank, 32% of the total vascular flora of Tasmania is considered naturalised (de Salas & Baker 2015); for the whole of Australia, the figure is estimated to be around 13% (Chapman 2009).

The severity of the impacts of naturalised plant species on the environment and on production systems is highly variable. Some taxa are widespread, common and invasive in both agricultural and natural habitats, whereas others may be merely a nuisance in home gardens. Regularly updating, documenting and anticipating where species currently or potentially will lie on this spectrum from relatively 'benign' to 'established management problem' assists in prioritising weed management effort.

Determining whether a taxon is naturalised in a region is a relative proposition. It will depend on the definition of 'naturalised' that is used and how this is interpreted and applied, and on the knowledge of the taxon, its history, ecology and behaviour within that region. Given the numbers of candidate taxa, these considerations are often subjective.

The process by which a plant taxon transitions from the accidental or deliberate introduction of propagules to a region to becoming

Abstract

Documenting the introduced plants of a region is an important aspect of understanding and managing the landscape. The dynamic nature of plant naturalisations means that the status of individual taxa may change with time. Taxa may become more widespread and common; others become the target of eradication initiatives. In some cases, species may be erroneously regarded as part of a flora because definitions of naturalisation may be variously interpreted and/or applied at different points in time. The present appraisal compared a defined set of statuses with the 150 taxa listed in the 2016 edition of *A Census of Vascular Plants of Tasmania, including Macquarie Island* as 'sparingly naturalised'. Eight taxa were found to be better described as 'status uncertain', six as 'previously naturalised', 22 as 'fully naturalised', 37 as 'not naturalised', 38 as 'doubtfully naturalised' and 39 remained as 'sparingly naturalised'.

Keywords: Introduced species, weeds, status.

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

naturalised within that region is dynamic and dependent upon a taxon successfully negotiating a series of biotic and abiotic barriers. These include environmental, reproductive, and dispersal barriers (Richardson *et al.* 2000). The biology of some taxa renders them incapable of overcoming one or more of the barriers posed at a given location and point in time and, therefore, they cannot be regarded as naturalised. Other taxa may have traits that facilitate a rapid transition to naturalisation. In addition, barriers may be somewhat dynamic and may diminish or strengthen at different points in time either to facilitate or inhibit the process of naturalisation.

Hardcopy 'floras', such as the *Flora of Australia* series (Flora of Australia 1981–), the *Flora of Victoria* (Foreman & Walsh 1993, Walsh & Entwisle 1994; 1996; 1999) and *The Student's Flora of Tasmania* (Curtis 1956; 1963; 1967; 1979, Curtis & Morris 1975; 1994), are foundation works that aid in the identification and documentation of a region's plant taxa. However, not all floras are complete (*Flora of Australia* is a case in point) and their hard-copy nature means that they are soon out-of-date with respect to records of new taxa, range extensions and retreats. This limitation of printed floras highlights a need for publication platforms and resources that are easily and quickly updated. Plant checklists and censuses are one tool that can be used to list naturalised taxa. They can be developed in a way that describes the naturalised status of each taxon in a given region and are far simpler to update than a traditional flora, making them a more reliable indication of a taxon's current status in a defined region. These documents take on many forms, from fully-searchable online databases such as *FloraBase* (WAH 1998–), *eFloraSA* (GSA 2016), *PlantNET* (GNSW 2016), and *Flora of Victoria* (VicFlora 2016), to simple lists such as the *Census of the Vascular Plants of Tasmania* (de Salas & Baker 2018). Individual resources vary in the degree of useful detail that they present for determining whether a species is naturalised or not: some display distribution maps based on collections; others list the number of herbarium specimens per pre-defined botanical region; others may describe a plant's geographic distribution and environmental preferences; or a combination of methods may be used. Distribution and abundance information on exotic taxa is important for their management, because it assists in the appropriate labelling and targeting of those taxa that pose a threat to biodiversity and agricultural production. Some censuses (e.g. de Salas & Baker 2015) do not usefully discriminate between unequivocally naturalised taxa, non-naturalised taxa and those taxa that sit somewhere in-between.

In Tasmania, the current names and synonyms of native and naturalised vascular plants have been catalogued and tracked in an evolving publication (the *Census*) produced by the Tasmanian Herbarium since 1989 (Buchanan *et al*. 1989; Buchanan 1995; 1999; 2005; 2007; 2009; Baker & Duretto 2011; Baker & de Salas 2012; 2013; de Salas & Baker 2014; 2015; 2016; 2017; 2018). The first edition of the *Census* (Buchanan *et al*. 1989) did not differentiate between native and naturalised taxa and simply listed them in alphabetical order. Further knowledge or information was needed to distinguish which taxa in the list were widespread weeds, rare endemics or common natives. The second edition (Buchanan 1995) rectified this and highlighted those taxa considered to be naturalised in Tasmania. The third edition (Buchanan 1999) included the following status 'sparingly naturalised or known from only one or two populations or collections' but it did not describe the meaning of 'sparingly naturalised'.

The definitions of 'naturalised' and 'sparingly naturalised' have not been adequately distinguished in the Tasmanian *Census* series, leading to a seemingly arbitrary assignment of the latter term to exotic taxa whose status is not well known. A consistent approach to assigning taxa to useful categories between naturalised and merely introduced is needed, especially for taxa not yet treated comprehensively in formal flora accounts or for which substantial new knowledge is now available.

Accurate definitions and their consistent application are useful to land management agencies for guiding weed management budgets and programs, and to determine when exotic species detected as part of developments and other assessments may have some local significance. The purpose of this paper is to introduce and apply a set of status definitions to the 150 taxa treated as 'sparingly naturalised' in the 2016 edition of *A Census of Vascular Plants of Tasmania, including Macquarie Island* (de Salas & Baker 2016).

Methods and Results

We assigned each taxon labelled 'sparingly naturalised'

in de Salas and Baker (2016) to the following status definitions:

Fully naturalised: Taxa that are growing outside of their natural range and outside of cultivation that have been introduced, whether intentionally or unintentionally, by humans, and occur in self-perpetuating, persistent and, where unoccupied niches exist, expanding populations.

Sparingly naturalised: Introduced taxa that are known from a small number of well-documented collections from non-cultivated sources where there is evidence of persistence but no evidence of significant spread or extensive ecological or agricultural impacts.

Doubtfully naturalised: Usually known from only a small number of collections, with notes accompanying the specimens offering scant information as to the population numbers or habitat information that could be used to deduce whether the plants are naturalised or not. They may be: one-off garden escapees that are transient; recorded only from domestic gardens with notes that are insufficient to determine a status; recorded only from a few collections from commercial crops but apparently not persistent; recorded only from old homesteads/abandoned gardens as remnants from previous cultivation.

Previously naturalised: Taxa that were once accepted as naturalised to some degree, but for which evidence indicates that targeted eradication has been achieved.

Not Naturalised: Taxa that lack evidence to suggest they were ever naturalised; that is, those that are known only from cultivated plants and without documented evidence of spread.

Status uncertain: Taxa for which evidence suggests an equivocal status; that is, it is not known whether they are native or naturalised. These taxa are generally characterised by having widespread native distributions in other Australian regions or are cosmopolitan throughout the world. They pose a dilemma for land managers with respect to whether they should be treated as weeds or as native species. The *status uncertain* taxa will not be treated any further in this work, but will be the topic of a future paper.

The primary source of evidence for determining a plant's status in this study is the collection of the Tasmanian Herbarium (HO). Information on some contemporary herbarium sheets was supplemented by personal communication with collectors of the specimens.

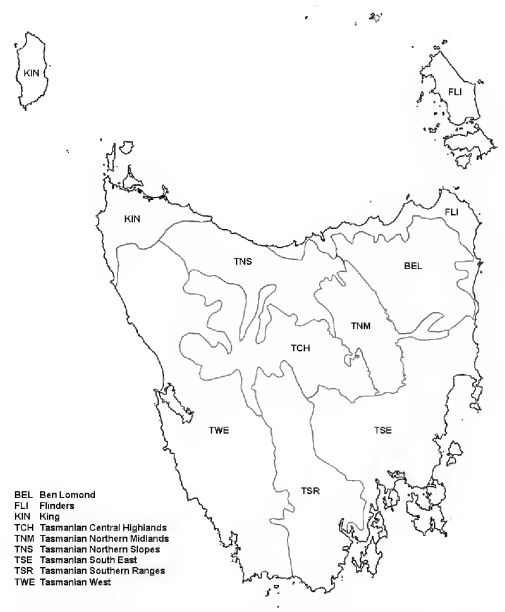

Figure 1. Biogeographic regions of Tasmania. (Adapted from: Interim Biogeographic Regionalisation for Australia (IBRA), Version 7).

Supplementary data from Australia's Virtual Herbarium (http://avh.ala.org.au/) was retrieved for records of taxa that are held in the following mainland Australian herbaria: National Herbarium of New South Wales (NSW); Australian National Herbarium (CBG & CANB); National Herbarium of Victoria (MEL); State Herbarium of South Australia (AD) [herbarium acronyms follow Holmgren *et al*. (1990)]. Four taxa listed as 'sparingly naturalised' in the Macquarie Island section of the *Census* are not discussed.

The results of the status determinations are given in the checklist below. Taxa are listed alphabetically within the larger groups of dicotyledons, monocotyledons and gymnosperms. Family classification follows Cronquist (1981) for angiosperms and McCarthy (1998) for gymnosperms, the same systems applied at the Tasmanian Herbarium (HO). Common names, for the most part, follow Wapstra *et al.* (2005).

For each taxon, selected herbarium specimens are listed chronologically and include the earliest and most recent records. Representative specimens from each Tasmanian IBRA bioregion (DoE 2012) a taxon occurs in are also included. Information for each specimen includes the unique herbarium registration code (if a collecting number is not known), the collector and

collecting number, date of collection, location and IBRA region (Figure 1). In most cases, specimens other than those in the Tasmanian Herbarium (HO) have not been seen by the authors (specimens not seen by the authors are annotated '*n.v.*') and their identity is assumed to be correct. They are included here for completeness in describing the Tasmanian distribution of those taxa. Information from the specimen collection data is also provided, along with published accounts of the taxon and, where applicable, the authors' observations. The extra-Tasmanian distribution is derived from the Australian Plant Census (CHAH 2015) and state and territory censuses and checklists. It includes those jurisdictions where the taxa are considered fully naturalised or native. Where a state or territory is listed, the taxon is considered to be naturalised unless noted otherwise.

Checklist

Dicotyledoneae

AIZOACEAE

Carpobrotus aequilaterus (Haw.) N.E.Br. (angled pigface)

Selected specimens examined (4 of 6): Roaring [Bay] Beach, 6 miles E [of] Dover (TSR), 23.i.1961, *T. Whaite 2313 and J. Whaite* (NSW [*n.v.*]); Remarkable Cave (TSE), 3.ii.1961, *J. Gray s.n.* (CBG 7900 [*n.v.*]); Cape Frederick Hendrick (TSE), 20.ix.1973, *D.A. Ratkowsky 405 and A.V. Ratkowsky* (NSW [*n.v.*]); Bellerive Bluff foreshore, near Bellerive Yacht Club starting box (TSE), 24.xi.2005, *C. Narkowicz s.n.* (HO 540318!).

Notes: This succulent perennial herb, occasionally grown as an ornamental, is known from coastal habitats in the southeast of Tasmania. It is likely that the populations have arisen from dumped garden refuse or spread from deliberate ornamental plantings. It is more widespread than indicated by formal collections, with plants also known to grow at Taroona Beach and on King Island.

Extra Tasmanian distribution: WA, NSW, Vic.

Status: Sparingly naturalised

Mesembryanthemum cordifolium L.f. [syn. *Aptenia cordifolia* (L.f.) Schwantes] (heartleaf iceplant)

Selected specimens examined (5 of 8): Yellow Beach, Flinders Island (FLI), 10.xi.1969, *J.S. Whinray 1949* (CANB [*n.v.*]; Creek Road, New Town (TSE), 2.v.1978, *D.I. Morris s.n.* (HO 26463!); South of Scamander (FLI), 18.ii.2003, *A.M. Buchanan 15998* (HO!); Near Knights Point, Windermere Bay, Glenorchy (TSE), 23.vii.2004, *A.M. Gray 1395* (HO!); Porter Hill, Sandy Bay Road (TSE), 22.iii.2010, *A.M. Gray 1960* (HO!).

Notes: This succulent perennial herb, most likely introduced to Tasmania as an ornamental garden plant, is widespread but uncommon and is known from localised populations at Flinders Island, Scamander and the greater Hobart region. It has been recorded in roadside vegetation, tip sites, high tide zones and in bushland adjacent to residential areas, but is as yet not considered fully naturalised due to its disjunct and usually highly localised occurrence.

Extra Tasmanian distribution: WA, SA, Qld, NSW, Vic.

Status: Sparingly naturalised

AMARANTHACEAE

Amaranthus graecizans L. subsp. *silvestris* (Vill.) Brenan (prostrate pigweed)

Specimen examined: Howick Street, Launceston (TNM), 6.ii.1981, *B.H. Hyde-Wyatt s.n.* (HO 38954!).

Notes: This low-growing, mat-forming annual is known in Tasmania from a single specimen collected from a residential garden in Launceston. There are no notes accompanying the specimen to indicate its status at the site, nor any evidence to suggest it is naturalised in Tasmania.

Extra Tasmanian distribution: SA, Vic.

Status: Not naturalised

Amaranthus spinosus L. (spiny pigweed)

Specimen examined: Perth Forestry Nursery (TNM), 15.ii.1995, [collector unknown] (HO 411361!).

Notes: This annual herb is known in Tasmania from a single specimen collected from a plant nursery. Its status at the site is unknown and there is no evidence to suggest it naturalised in Tasmania.

Extra Tasmanian distribution: NT, Qld, NSW

Status: Not naturalised

APIACEAE

Aegopodium podagraria L. (goutweed)

Specimens examined: New Town (TSE), 23.xii.1968, *D.I. Morris s.n.* (HO 52091!); Hobart, New Town Research Laboratory grounds (TSE), 31.xii.1976, *D.I. Morris s.n.* (MEL0532712 [*n.v.*]);

New Town Research Laboratories (TSE), 1.i.1977, *D.I. Morris s.n.* (HO 25220!).

Notes: This perennial herb is known in Tasmania from the grounds of the State agricultural department's laboratories in suburban Hobart and from a garden nearby. One specimen states 'New introduction into Tasmania'. However, there is no information accompanying the collections that offers any detail regarding its status at these sites and there is insufficient evidence to suggest it is naturalised in Tasmania.

Extra Tasmanian distribution: NSW, Vic.

Status: Not naturalised

ASTERACEAE

Centaurea calcitrapa L. (star thistle)

Specimens examined: Southern Tasmania, 1889, *J. Fletcher s.n.* (MEL2157846 [*n.v.*]); Near Oatlands (TSE), xi.1899, *L. Rodway 445* (HO!); Circular Head (TNS), 12.iv.1913, *R.A. Black s.n.* (MEL2300850 [*n.v.*]); Sheffield, area school (TNS), 19.ii.1947, *M.J. Firth s.n.* (HO 53308! & HO 10525!).

Notes: Curtis (1967) described the distribution and habitat of this annual or biennial herb as "occasional in waste places in the north of the State". It is listed in Rodway (1903) but without any notes on its distribution. It has not been recorded in Tasmania in more than 70 years and no contextual details accompany any specimens, making a determination of its status difficult. The presence of several early records from widely separated regions indicates that it may, in the past, have been naturalised to some degree. However, it seems likely that it no longer occurs in the State.

Extra Tasmanian distribution: WA, SA, Qld, NSW, ACT, Vic.

Status: Doubtfully naturalised

Centaurea cyanus L. (cornflower)

Specimens examined: Launceston (Cultivated?)(TNM), 23.x.1978, *B.H. Hyde-Wyatt s.n.* (HO 586771!); Bothwell, 2 km E of town, Lake Highway (TSE), 12.v.2008, *M.L. Baker 1879* (HO!); Kettering (TSE), 16.xi.2013, *M. Wapstra 1730* (HO!).

Notes: This occasionally cultivated annual herb is known in Tasmania from three widely separated records. One is possibly a cultivated plant as it was recorded from a garden. The others were collected from roadside verges in rural parts of the State. The presence of sporadic plants from disjunct regions indicates that it may have the potential to become naturalised to some degree in the State.

Extra Tasmanian distribution: NSW

Status: Doubtfully naturalised

Centaurea solstitialis L. (St Barnaby's thistle)

Specimen examined: Meander Valley, near Deloraine (TNS), i.1916, *L. Rodway 444* (HO!).

Notes: This annual herb with spiny flower heads is known in Tasmania from a single specimen collected more than 100 years ago. Curtis (1963) described its distribution and habitat as "an occasional weed in the north of the State." There is no information accompanying the collection that offers any detail regarding its status at the site and there is insufficient evidence to suggest it naturalised in Tasmania.

Extra Tasmanian distribution: WA, SA, Qld, NSW, Vic.

Status: Not naturalised

Cynara cardunculus L. subsp. *flavescens* (Wiklund artichoke thistle)

Specimens examined: McRobies Gully, Hobart (TSE), 27.vi.1986, *A.M. Buchanan 8802* (HO!); Bridgewater, near site of former Bridgewater Railway Station (TSE), 6.v.2003, *M.L. Baker s.n.* (HO 521921!).

Notes: This spiny thistle, related to the globe artichoke (*C. cardunculus* L. subsp. *cardunculus*), is known in Tasmania from two collections from the greater Hobart area. One specimen is noted as possibly being a cultivation escapee spreading into vacant land. The population was made the target of eradication and is considered to have been eradicated (K. Stewart pers. comm.). The other specimen is presumed to be from dumped garden refuse and has not been recorded since.

Extra Tasmanian distribution: WA, SA, NSW, ACT, Vic.

Status: Previously naturalised

Lactuca serriola L. forma *integrifolia* (Gray) S.D.Prince & R.N.Carter (prickly lettuce)

Specimens examined: Tomahawk Refuse Site (FLI), 11.i.2004, *M.L. Baker 1323* (HO!); Blackwood Creek (TNM), 29.i.2011, *R. Smith s.n.* (HO 561952!).

Notes: This erect prickly annual herb is known in Tasmania from two specimens, one from a weed-infested tip site surrounded by coastal bushland in the State's northeast, and the other as a crop weed. No collection details describing the plants population or status at either of the sites are given. The taxon may be

overlooked for the typical form, which is common and widely naturalised in Tasmania.

Extra Tasmanian distribution: SA, NSW, ACT, Vic.

Status: Doubtfully naturalised

Matricaria chamomilla L. (chamomile)

Specimens examined: Scotts Road, Risdon Vale (TSE), 3.xi.1993, *H. Blackburn s.n.* (HO 517199!); Scotts Road, Risdon Vale (TSE), 29.xi.1993, *D.I. Morris s.n.* (HO 409495!).

Notes: This occasionally cultivated annual herb is known in Tasmania from two specimens that are likely to have been collected from the same site. The collections are devoid of useful notes that give any indication of the status at the time of collection other than being thought to have arisen from bird seed. It is not known if the plants have persisted at this site.

Extra Tasmanian distribution: WA, SA, NSW

Status: Doubtfully naturalised

Onopordum acaulon L. (stemless thistle)

Specimen examined: 'Charlton Park', near Melton Mowbray, North of Mt Mercer trig point (TSE), 6.xii.2002, *G. Raphael s.n.* (HO 520128!).

Notes: This low-growing, rosette-forming thistle is known in Tasmania from a highly localised population of fewer than 20 plants that grew where imported cattle feed was spread. The population was made the target of eradication and is considered to have been eradicated (K. Stewart pers. comm.).

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Previously naturalised

Pilosella officinarum Vaill. subsp. *officinarum* [syn. *Hieracium pilosella* L.] (mouse-ear hawkweed)

Specimens examined: 'St Peters Pass', N of Oatlands (TSE), 6.i.2001, *A. Woolley s.n.* (HO 510506!); 'St Peters Pass' property, [near Oatlands] (TSE), 31.i.2001, *A.M. Buchanan 15829* (HO!).

Notes: This perennial herb is known in Tasmania from a single population growing on a rural fence line between a roadside reserve and pasture. Shortly after its discovery, the infestation site was excavated and deep buried and eradication was achieved (Rudman & Goninon 2002, as *H. pilosella*). Before it was eradicated, it was the dominant component of the vegetation over an area of approximately 2,500 m^2. Monitoring of the site until 2006 did not find any further plants (K. Stewart pers. comm.). *Pilosella officinarum* is an invasive weed in cool climate areas of North America and New Zealand.

Extra Tasmanian distribution: ACT, NSW (recent incursion (P. Turner pers. comm.))

Status: Previously naturalised

Senecio angulatus L.f. (scrambling groundsel)

Selected specimens examined (6 of 11): Moonah (TSE), 24.iv.1982, *D. Secomb s.n.* (HO 569321!); Kaoota Road, Allens Rivulet (TSR), 11.iii.2001, *L.H. Cave s.n.* (HO 511532!); Strahan, Regatta Point (TWE), 14.ix.2004, *M.L. Baker 543* (HO!); Whitemark, old tip site (FLI), 14.i.2007, *A.M. Buchanan 16638* (HO!); Tasman Island, garden of Quarters 3 (TSE), 29.ix.2007 *P.A. Tyson 580* (HO!); South Arm, Blessington Street (TSE), 24.viii.2010, *P. Norris s.n.* (HO 563422!).

Notes: This vigorous scrambling shrub, occasionally grown as an ornamental, is widespread and localised throughout the state but is most often encountered on the east and southeast coasts. It has been recorded smothering native vegetation in a variety of habitats including tip sites, roadsides, gullies, sand dunes and remnant coastal vegetation; in some cases it dominates large areas of c. 1,000 m^2. It is more widespread than indicated by formal collections, with Wapstra *et al.* (2008) reporting populations at Eddystone Point on the northeast coast and in the upper Derwent Valley.

Extra Tasmanian distribution: WA, SA, Qld, NSW, Vic.

Status: Naturalised

Taraxacum kok-saghyz L.E.Rodin (Russian dandelion)

Specimens examined: Cressy Experimental Farm (cult.) (TNM), 27.x.1943, *W.M. Curtis s.n.* (HO 53346! & HO 15165!).

Notes: This perennial herb is known from two collections that appear to be duplicates. Curtis (1963) stated that it was "cultivated at Cressy during the war of 1939–1945 as a source of latex, a possible substitute for rubber; probably persisting locally". It has not been recorded since. See Figure 2.

Extra Tasmanian distribution: None

Status: Not naturalised

BASELLACEAE

Anredera cordifolia (Ten.) Steenis (Madeira vine)

Selected specimens examined (5 of 6): Launceston (TNM), 3.v.1965, [collector unknown] (HO 506475!); Clark Island, near original homestead (FLI), ix.1980, *S. Harris 113* (HO!); South

Figure 2. *Taraxacum kok-saghyz* has not been recorded since it was cultivated as a crop plant in the 1940s. It is considered to be not naturalised in Tasmania.

Street, Bellerive (TSE), 10.iv.1985, *D.I. Morris 8551* (HO!); 15 Channel Street, Burnie (TNS), 2000, *K. Kirkely s.n.* (HO 510807!); 145 Davey Street, Hobart (TSE), 3.v.2001, *D.I. Morris 86734*, (HO!).

Notes: This ornamental perennial vine was first recorded in waste places at Launceston. Subsequent collections are from disjunct locations throughout the State and are associated with suburban and city gardens. There is no evidence of spread from these sites, some of which appear to have been eliminated (e.g. HO 102250, HO 328680), while the current status of others is unknown. Curtis (1967) described it as "a garden escape, naturalised locally in the north of the State". However, there is no evidence to support this.

Extra Tasmanian distribution: WA, SA, Qld, NSW, Vic.

Status: Doubtfully naturalised

BETULACEAE

Alnus cordata (Loisel.) Duby (Italian alder)

Specimens examined: St Marys (BEL), viii.1950, *H.N. Barber s.n.* (HO 36203!); Watchorn Street, Hobart (cult.) (TSE), 19.v.2004, *M.F. Duretto 1744* (HO!).

Notes: This ornamental deciduous tree is known in Tasmania from two widely-spread collections, one from a cultivated plant in Hobart and the other from the town of St Marys. Curtis (1967) stated that it is "recorded from the east coast at St Marys and from river banks near New Norfolk". However, no specimens from New Norfolk have been seen and there are no notes accompanying the specimen from St Marys to indicate its status at the site. **Extra Tasmanian distribution**: None

Status: Not naturalised

Alnus glutinosa (L.) Gaertn. (black alder)

Specimens examined: Huonville, picnic area E of bridge (cult.) (TSR), 8.i.1984, *M. Williams s.n.* (HO 76693!); Macquarie Street, Hobart (cult.) (TSE), 27.v.1988, *W.M. Curtis s.n.* (HO 110455!); Murray Street, 10 m N of Melville Street, Hobart, (cult.) (TSE), 19.v.2004, *M.F. Duretto 1745* (HO!); Queenstown, CMT Industrial Estate (TWE), 9.ii.2007, *G. Cordery s.n.* (HO 544184!); King River Delta, Lettes Bay (TWE), 7.viii.2007, *M.L. Baker 1807 and A. Laird* (HO!).

Notes: This deciduous tree is cultivated in Tasmania as an ornamental. Two of the five collections appear to be from non-cultivated plants. One was a single plant growing with *Baloskion tetraphyllum* on accumulated sediment at the mouth of the King River at Lettes Bay, Strahan. The other collection, from the Queen River, Queenstown, has the following notes attached: "*Alnus* is spreading along Queen River. The extent of alder tree dispersion in the Queenstown locale is unknown at present; further investigations are required to determine populations". Without further evidence it would be premature to assign a naturalised status to this species.

Extra Tasmanian distribution: NSW, ACT

Status: Doubtfully naturalised

BORAGINACEAE

Lithospermum officinale L. (gromwell)

Selected specimens examined (5 of 9): First Basin, Launceston, Midlands (TNM), 27.xi.1938, *A.M. Olsen s.n.* (HO 7842!); Entrance to [Cataract] Gorge, Launceston (TNM), xi.1945, *W.M. Curtis s.n.* (HO 505445!); Trevallyn Reserve (TNM), 11.iii.2006, *R. Skabo s.n.* (HO 538846!); Thrower Street, Launceston (TNM), 4.xii.2007, *R. Skabo s.n.* (HO 546890!); Launceston (TNM), x, *S.G. Hannaford s.n.* (HO 7841!).

Notes: This perennial herb is locally naturalised in the Launceston area, particularly near Cataract Gorge, where it has persisted for nearly 80 years since it was first recorded. Collection notes indicate that it forms relatively large and persistent populations. The source of the plants is not known. Curtis (1967) described the distribution and habitat as "occasional in waste places", but there is no evidence that it ever extended beyond the Launceston area.

Extra Tasmanian distribution: None

Status: Naturalised

Symphytum × *uplandicum* Nyman (Russian comfrey)

Specimens examined: Huon (TSR), 1957, *F. Fricke s.n.* (HO 505422! & HO 8014!); Underwood, junction of Underwood and Ryans Roads (BEL), 11.ii.2009, *M.L. Baker 1955* (HO!); Mole Creek (TNS), 2.ii.2008, *A.M. Buchanan 16859* (HO!); Kingston, old 'Linden Rise' property (TSE), 14.ii.2013, *M. Wapstra 1540* (HO!).

Notes: This erect perennial herb is known in Tasmania from several disjunct occurrences. Associated collection notes regarding the size and area of the populations are limited. However, the Underwood and Kingston collections are reported to consist of one and two plants respectively. Curtis (1967) noted its distribution in Tasmania as "occasional on roadsides as an escape from cultivation".

Extra Tasmanian distribution: Vic. (sparingly established)

Status: Doubtfully naturalised

BRASSICACEAE

Brassica ×juncea (L.) Czern. (Indian mustard)

Specimens examined: Hobart, Queens Domain, corner of Domain Highway and Botanic Gardens Road (TSE), 3.vi.1998, *A.M. Buchanan 15268* (HO!); Hobart, Queens Domain, strip of remnant bushland between bicycle track and Lower Domain Road (TSE), 14.x.2015, *M.L. Baker 3006 and A. Muyt* (HO!).

Notes: This annual herb is known in Tasmania from a localised population at the Queens Domain, Hobart, where it has persisted for nearly 20 years since it was first recorded. The population covers an area of approximately 30 x 30 m in a weed-infested grassy woodland. Its persistence at the site and its ability to reproduce and regenerate indicate that it is naturalised to some degree. Its localised distribution would suggest that it is only sparingly naturalised.

Extra Tasmanian distribution: WA, NT, SA, Qld, NSW

Status: Sparingly naturalised

Brassica oleracea L. (wild cabbage)

Selected specimens examined (6 of 12): Hobart (TSE), xii.1903, *L. Rodway 32a* (HO!); Mole Creek (TNS), xii.1908, *L. Rodway 32* (HO!); Sandy Bay, Hobart (cult.) (TSE), 17.ii.1952, *W.M. Curtis s.n.* (HO 15478!); Foreshore, Town Point (TNM), 11.iii.1961, *J. Somerville s.n.* (HO 15467!); New Year Island (KIN), 20.xi.1987, *N.P. Brothers s.n.* (HO 441808!); Christmas Island off King Island (KIN), 3.i.2002, *K. Medlock s.n.* (HO 519030!).

Notes: This annual herb has been collected widely throughout Tasmania and has been recorded from most bioregions including some outlying sites such as smaller Bass Strait islands. Notes associated with the collections do not indicate the abundance or status of the plants from these sites. Early collections are presumed to have originated from kitchen gardens. Curtis (1956) commented that it "…is found occasionally as an escape from cultivation", but did not treat it as naturalised. Despite the numerous collections, there is little evidence to support even a sparingly naturalised status. See Figure 3.

Extra Tasmanian distribution: WA, NT, SA, NSW, Vic.

Status: Doubtfully naturalised

Carrichtera annua (L.) DC. (Ward's weed)

Specimen examined: 'Lomatia Vale', Clarks Road, Lower Longley (TSR), 3.xi.1985, *A.M. Gray s.n.* (HO 94051!).

Notes: This erect annual herb is known in Tasmania from a single specimen collected from a garden at Longley. Notes accompanying the specimen state that only a single plant was found and that it was probably introduced with fowl feed. Based on this information it is difficult to justify any degree of naturalised status for the species in Tasmania.

Extra Tasmanian distribution: WA, NT, SA, NSW, Vic.

Status: Not naturalised

Eruca sativa Mill. (purple-vein rocket)

Specimens examined: Tasmania (cult.) (TSE), 5.xii.1971, *R.J. Hnatiuk s.n.* (CANB 246483 [*n.v.*]); Primrose Place, Sandy Bay (cult.) (TSE), 11.xii.1981, *W.F. Walker s.n.* (HO 46453!); University of Tasmania, Hobart (cult.) (TSE), xii.1996, *R. Wiltshire s.n.* (HO 443113!); Darling Parade, Mt Stuart (TSE), 21.iv.2005, *M.F. Duretto 1866* (HO!).

Notes: This edible annual herb is known in Tasmania from four collections with notes indicating that they were either self-sown in gardens or deliberately cultivated. Based on this information it is difficult to justify any level of naturalised status for the species in Tasmania.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Not naturalised

Lepidium heterophyllum Benth (downy peppercress)

Specimens examined: Cressy (TNS), xii.1973, *D.I. Morris s.n.* (HO 29388!); Cressy Research Farm (TNS), *J. Somerville s.n.* (HO 15715!).

Notes: This perennial herb is known in Tasmania from two specimens collected from Cressy in the State's central north. One specimen's collecting information states that it was growing on the bank of an irrigation ditch but gives no indication of the population size or area covered by the species. The other has no information regarding its status at the collection site. Curtis and Morris (1975) described it as "occasional in waste places". In the absence of further collections, and the possibility that both collections are from the one highly anthropogenic location, there is little support to justify any degree of naturalised status for it in Tasmania.

Extra Tasmanian distribution: None

Status: Not naturalised

Lunaria annua L. (honesty)

Selected specimens examined (6 of 15): Port Arthur (TSE), 1892, *J. Bufton A* (MEL2233709 [*n.v.*]); Fern Tree (TSE), 13.i.1983, *D.I. Morris 8306* (HO!); Longford (TNM), 13.x.1994, *A.*

Figure 3. *Brassica oleracea* is an example of a species that is doubtfully naturalised in Tasmania. Although several specimens exist, and from disjunct locations, there are no notes to give any context as to the species' status.

Bishop s.n. (HO 323066!); Dover (TSR), 29.x.2002, *T. Rudman s.n.* (HO 520018!); Scottsdale tip off Bridport Road, c. 200 m N of Jetsons Road junction (BEL), 11.i.2005, *M.L. Baker 1350* (HO!); Mt Wellington (TSE), 25.ix.2006, *M. Wapstra 22* (HO!).

Notes: This occasionally cultivated biennial herb is widespread in Tasmania and is common especially in and around the greater Hobart region. Naturalised populations have been recorded growing in a range of habitats, including roadside verges, shorelines, stream banks and pasture.

Extra Tasmanian distribution: SA, NSW, Vic.

Status: Naturalised

Nasturtium microphyllum Boenn. ex Rchb. (one-row watercress)

Selected specimens examined (6 of 13): Near Cataract [Gorge], Launceston (TNM), xi.1865, [collector unknown] (NSW 137706 [*n.v.*]); At the base of Mount Field East, and at Jones River (TSR), i.1867, *F. Mueller s.n.* (MEL0093363 [*n.v.*]); Mole Creek (TNS), xii.1908, L. Rodway 25a (HO!); Apsley (TSE), 20.xii.1978, *D.I. Morris s.n.* (HO 30970!); Ocean Beach. 5 km W of Strahan (TWE), 7.ii.1981, *A.E. Orchard 5368* (HO!); South Road coastal block, 100 m from coast, King Island (KIN), 1.xii.2009, *M. Batey 99 and G. Batey* (HO!).

Notes: This semi-aquatic perennial herb is known in Tasmania from several collections spanning a long period of time and with a wide distribution. Recent examination of material held in the Tasmanian Herbarium has identified several specimens of *N. microphyllum* from material previously identified as *Nasturtium officinale* W.T.Aiton. It is possible that this it is more widespread in the State as it is likely to have been overlooked due to its resemblance to the widespread and common *N. officinale*. To distinguish the two species, fertile material with mature fruits is required. Curtis and Morris (1975) described its habitat as being the same as where *N. officinale* is found; that is, streams and ditches in moving water.

Extra Tasmanian distribution: SA, Qld, NSW, Vic.

Status: Naturalised

Raphanus maritimus Sm. (sea radish)

Specimens examined: Bridgewater (TSE), 9.xi.1942, *H.D. Gordon s.n.* (HO 29355!); Wynyard, township (TNS), 18.i.1964, *A. Colebrook 8816* (NSW 641428 [*n.v.*]).

Notes: This annual herb is known in Tasmania from two disjunct locations. Information on both suggests they were not from cultivated plants. The Bridgewater collection is from an "embankment", whereas the Wynyard collection is annotated as being "not cultivated". It has not been recorded in Tasmania for more than 50 years and, without details of the habitat or populations at these sites, there is insufficient evidence to suggest that it is naturalised in Tasmania.

Extra Tasmanian distribution: Vic.

Status: Doubtfully naturalised

Rorippa sylvestris (L.) Besser (creeping yellowcress)

Specimens examined: Cradoc Hill Road, near Cradoc (TSR), 4.xii.2000, *D.I. Morris 86721* (HO!); Valleyfield, New Norfolk (TSE), 12.i.2001, *A.M. Buchanan 15825* (HO!); Cradoc Hill Road, Lilium farm on W side of road (TSR), 19.i.2004, *A.M. Buchanan 16093* (HO!); Mountain River Road, ~1.5km from Grove intersection, Mountain River (TSR), 19.i.2004, *M.L. Baker 402* (HO!); Valleyfield, New Norfolk (TSE), 23.i.2004, *M.L. Baker 401* (HO!).

Notes: This perennial herb has a distribution that is localised and restricted in southern Tasmania. It is well-established and a troublesome weed at several sites including Cradoc Hill Road, where it was recorded in a weed-infested paddock after it was accidentally introduced via imported *Lilium* bulbs. In April 2018 many plants were persisting at this site. It has also been recorded from a blackcurrant crop at New Norfolk. The species does not reproduce by seed and reproduction and dispersal is via transport of rhizomes. Based on the above evidence, *R. sylvestris* appears to be sparingly naturalised in Tasmania.

Extra Tasmanian distribution: SA, Vic.

Status: Sparingly naturalised

Thlaspi arvense L. (penny cress)

Specimens examined: Togari (KIN), 16.xi.1976, *J. Lees s.n.* (HO 576402!); 'Leamington', Pawtella (TSE), 14.x.1991, *S. Geard s.n.* (HO 142638!); 'Leamington', Pawtella (TSE), 11.x.1991, *S. Geard s.n.* (HO 142639!).

Notes: This erect annual herb is known in Tasmania from two widespread locations: Togari in the State's northwest, and Pawtella in the south. The Pawtella specimen was from a rape crop, but there is no indication of the number of plants or its history or status at the site. The collection from Togari is devoid of contextual notes. In the absence of information, there is doubt regarding its naturalised status in Tasmania.

Extra Tasmanian distribution: NSW, Vic. (previously naturalised)

Status: Doubtfully naturalised

CALLITRICHACEAE

Callitriche brutia Petagna subsp. *brutia* (stalked waterstarwort)

Specimen examined: Houfes Road, King Island (KIN), 30.x.1998, *A. Woolley s.n.* (HO 446766!).

Notes: This aquatic herb is known in Tasmania from a single specimen that was collected from a roadside drain on King Island. There is insufficient information to suggest that it has become naturalised, but follow-up surveys at the site are warranted to check its persistence.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Doubtfully naturalised

CAMPANULACEAE

Campanula rapunculoides L. (creeping bellflower)

Specimens examined: Tasmania (cult.), 27.xii.1948, [collector unknown] (HO 53435!); Tasmania (cult.), 29.xii.1949, [collector unknown] (HO 8173!); Tasmania, 3.xii.1954, [collector unknown] (HO 8174!); New Town (TSE), 5.ix.1989, *D.I. Morris 86399* (HO!); Ruth Drive, Lenah Valley (TSE), 20.ii.2012, *M. Wapstra 1345* (HO!).

Notes: This cultivated perennial herb is known in Tasmania from five collections. The three earliest are from unknown locations: two are noted as being cultivated and the third as a "garden escape". The notes associated with these specimens are scant. The recent collections were recorded from the base of a retaining wall in a residential garden and from a railway line at the former New Town railway station. Recent surveys in the latter area failed to re-locate it (M. Wapstra pers. obs.). Curtis (1963) stated that the species is "persisting on roadsides and in waste places near gardens". There is insufficient information to suggest that this species has become naturalised in Tasmania.

Extra Tasmanian distribution: Qld (formally naturalised), NSW (Sparingly naturalised)

Status: Doubtfully naturalised

Lobelia erinus L. (bedding lobelia)

Selected specimens examined (5 of 7): Mt Stuart Road, Hobart (TSE), 5.iv.2006, *M.F. Duretto 2124* (HO!); Trevallyn Nature Recreation Area (TNM), 10.xii.2010, *R. Skabo s.n.* (HO 566884!); East of Ansons Bay Road (BEL), 20.xi.2011, *R. Skabo s.n.* (HO 563964!); Mount Nelson, E side of Rialannah Road (TSE), 17.iv.2012, *M. Wapstra 1357* (HO!); Channel Highway [Middleton] (TSE), 4.iii.2013, *M. Wapstra 1549* (HO!).

Notes: This sprawling perennial garden plant, despite being represented only by relatively recent collections from the 2000s, is widespread in Tasmania. It is most often recorded as a few or single plants. However, a population from the Channel Highway was noted as being locally abundant, with 100s to 1000s of plants spread over a hundred metres or so of roadside table drain. One population, recorded from a sandstone wall that divides Mount Stuart Road, is long-persistent, flowers each year and seems to spread further each growing season (M. Wapstra pers. obs.). Plants have been recorded growing in a number of different habitats including roadsides, banks of suburban rivulets and grassy woodland. While there are several collections from widespread locations and different habitats, the species is still considered only sparingly naturalised due to its usually localised occurrence. However, the propensity for the species to spread is noted and this may be an example of a species that will shift category in a short time frame.

Extra Tasmanian distribution: SA, NSW, Vic.

Status: Sparingly naturalised

CAPRIFOLIACEAE

Lonicera periclymenum L. (European honeysuckle)

Specimens examined: Old town of Guildford (TCH), 2.ii.2014, *M. Wapstra 1813* (HO!); Camp Creek, Currie, King Island (KIN), 25.ii.2009, *M.L. Baker 2054* (HO!); Zeehan, West Coast (TWE), 9.xii.1954, *W.M. Curtis s.n.* (HO 52083!).

Notes: This vigorous, evergreen climber is known in Tasmania from three widely separated locations. The specimens come from an old homestead site at Guildford, a roadside at Zeehan and a weedy creek bank on King Island. It is possible that there are more populations and that it may have been overlooked for the widespread and naturalised *L. japonica* Thunb.

Extra Tasmanian distribution: None

Status: Sparingly naturalised

Viburnum tinus L. (laurustinus)

Selected specimens examined (6 of 11): Whites Mill Road, Lilydale (BEL), 11.ix.1983, *A.M. Buchanan 1206* (HO!); Long Island (FLI), 1.xii.1986, *S. Harris s.n.* (HO 104804!); Cataract Gorge, Launceston. Cataract walk between Kings Bridge and First Basin (N side of river) (TNM), 14.x.2005, *M.L. Baker 1692* (HO!); Mount Wellington, Pipeline Track, above track (TSE),

16.viii.2009, *M. Wapstra 916* (HO!); Prospect, bushland reserve between Country Club Avenue and Las Vegas Drive (TNM), 16.x.2013, *M. Wapstra 1456* (HO!); Cataract Gorge, track from Kings Bridge to Gorge (TNM), 7.xi.2017, *M.L. Baker 3383* (HO!).

Notes: This commonly cultivated ornamental shrub is known in Tasmania from several collections mainly from single plants persisting at the sites of abandoned gardens. The most recent record notes that several juvenile plants were encountered and were probably the result of dumped garden refuse. Whether these plants have persisted at this site is unknown. The species produces copious amounts of fleshy fruit that are consumed and dispersed by birds (Karlsson 2005). A recently-observed locally naturalised population at Cataract Gorge, Launceston, consisted of many plants of varying size and age. Cultivated plants of *V. tinus* at an abandoned homestead in bushland in Glenorchy were observed to be heavily grazed by ground-dwelling marsupials, indicating that it is palatable to wildlife (M. Baker pers. obs.). It is thought that browsing of seedlings limits the opportunity of this species to naturalise in Tasmania.

Extra Tasmanian distribution: SA, ACT, Vic.

Status: Sparingly naturalised

CARYOPHYLLACEAE

Silene conica L. (striated catchfly)

Specimen examined: King Island, Bass Strait (KIN), 20.ii.1931, *A.E. Scott s.n.* (AD 98664081 [n.v]).

Notes: This annual herb is known in Tasmania from a single specimen collected from King Island more than 85 years ago. With no accompanying notes on habitat or population details, there is little evidence to suggest it is naturalised in Tasmania.

Extra Tasmanian distribution: Vic.

Status: Not naturalised

Silene dichotoma Ehrh. (forked catchfly)

Specimens examined: Tasmania, *R.A. Black s.n.* (HO 8561!); Sandy Bay (TSE), iv.1913, *L. Rodway 65c* (HO!); Queens Domain, Hobart, Davies Avenue (near Hobart Aquatic Centre) (TSE), 5.x.2009, *M.L. Baker 2102* (HO!); Cressy Beach, Middle headland (TSE), 26.x.2009, *M. Wapstra 982* (HO!); Royal Tasmanian Botanical Gardens, grassland area at N tip of gardens (TSE), 26.xi.2010, *M.L. Baker 2350* (HO!).

Notes: This annual or biennial herb is known in Tasmania from a small number of small but established populations. Two of these occur on the Queens Domain in Hobart whilst the third is at Cressy Beach on the State's east coast. This species is established in Tasmania but the small scale and number of sites suggest it should be considered only sparingly naturalised.

Extra Tasmanian distribution: Vic.

Status: Sparingly naturalised

Silene colorata Poir. (=*Silene longicaulis* auct. non Pourr. ex Lag. sensu Buchanan (1995)) (pink catchfly)

Specimens examined: South Arm, 12.ii.1899, *F.A. Rodway 658* (NSW 676460!); South Arm (all TSE), xii.1905, *L. Rodway 65A* (HO!).

Notes: This annual herb is known in Tasmania from only two specimens collected from South Arm in the State's southeast. The name *S. longicaulis* was, until recently, misapplied to a specimen of *S. colorata* and it was this specimen that led to the species being included in the 1995 edition of the *Tasmanian Vascular Plant Census* (Buchanan 1995). Due to the lack of notes accompanying the collections it is difficult to determine its status in Tasmania. Having not been collected or recorded in the State for more than 110 years strongly suggests it is no longer present. For a detailed discussion of this species in Tasmania see Baker (2016).

Extra Tasmanian distribution: None

Status: Not naturalised

Stellaria graminea L. (lesser stitchwort)

Specimens examined: Tyenna (TSR), 15.xi.1903, *L. Rodway s.n.* (HO 8634!); Sea Elephant River, King Island (KIN), 9.i.1979, *D.I. Morris 7964* (HO!).

Notes: This perennial herb is known in Tasmania from two disjunct locations. One specimen was collected more than 100 years ago from Tyenna and the other was collected nearly 40 years ago from King Island. Whilst there is no information indicating the species' status, given the two geographically and temporally separated records, it is possible it is more widespread but perhaps overlooked. Curtis (1956) stated that it is "occasional in shaded places and amongst bracken". Given the lack of recent collections and informative collecting information it is difficult to apply a naturalised status to this species with any certainty.

Extra Tasmanian distribution: NSW, Vic. (previously naturalised)

Status: Doubtfully naturalised

Vaccaria hispanica (Mill.) Rauschert (cow soapwort)

Specimen examined: Hobart (TSE), (no other collection information recorded. Annotated in Leonard Rodway's handwriting), (HO 8647!).

Notes: This annual herb is known in Tasmania from a single, poorly-annotated collection thought to have been collected by Leonard Rodway, although Rodway (1903) does not mention it. Curtis (1956) described its distribution and habitat (as *V. segetalis*) as "occasional in cultivated ground". However, the basis for this observation is not known. From this scant information it is difficult to assign a naturalised status with any certainty.

Extra Tasmanian distribution: WA, NT, SA, Qld, NSW, Vic.

Status: Not naturalised

CHENOPODIACEAE

Bassia scoparia (L.) A.J.Scott (kochia)

Specimens examined: Quamby View, near Deloraine, Midlands (TNS), 22.ii.1995, *A. Allwright s.n.* (HO 411060!); Quamby View near Deloraine, Midlands (TNS), 8.iv.1997, *D. Green s.n.* (HO 12302! & HO 320884!); Quamby View, near Deloraine, Midlands (TNS), 08.iv.1997, *A. Allwright s.n.* (MEL0258971 [*n.v.*]); Winspears Road, Ambleside, East Devonport (FLI), i.1998, *A. Loane s.n.* (HO 324601!).

Notes: This annual herb is known in Tasmania from two locations. The latest record is devoid of useful collecting notes that give any indication of its status, although the location is predominantly rural land. All other records are from a carrot crop at the one site but collected over two different years, indicating some persistence at the site or a possible reintroduction as a contaminant of crop seed. This potentially troublesome crop weed has not been collected since and it is unknown if it has persisted at the sites.

Extra Tasmanian distribution: WA, SA

Status: Doubtfully naturalised

Chenopodium foliosum (Moench) Asch. (=*Chenopodium capitatum* auct. non (L.) Ambrosi sensu Buchanan (2009)) (leafy goosefoot)

Specimens examined: New Town, Hobart, 10 Senator Street (TSE), 23.ii.1982, *J.E.S. Townrow s.n.* (HO 115888!); Lenah Valley, S side [of Augusta Road](TSE), 17.ii.2008, *M. Wapstra 466* (HO!); Augusta Road, Lenah Valley, Hobart (TSE), iii.2010, *M. Wapstra 1100* (HO!).

Notes: The two recent collections of this annual herb are from a single plant, noted as growing in a suburban drain. The plant persisted into 2009 and 2010, despite being virtually uprooted in 2008 (Wapstra 2008 as *C. capitatum*). It was eliminated by DPIPWE weed management officers in 2010 and has not reappeared since (M. Wapstra pers. obs.). The collection from Senator Street in the same suburb in 1982 was growing in a garden. Searches in the area during 2008-2010 failed to detect any plants in the vicinity. Given this information it is reasonable to consider that this species was never truly naturalised in Tasmania.

Extra Tasmanian distribution: None

Status: Not naturalised

CISTACEAE

Cistus inflatus Pourr. ex Demoly (rock rose)

Specimens examined: Hadspen near bridge over South Esk River (TNM), 7.iii.1998, *A.M. Buchanan 15138* (HO!); Hadspen (TNM), 19.iii.1998, *A.M. Buchanan 15160* (HO!); Hadspen, side of road to disused jetty on South Esk River (TNM), 1.xii.2004, *M. Baker 1141* (HO!).

Notes: This ornamental shrub is known only from collections from Hadspen in the State's north. It is represented by a single localised population that has been persistent at the site for almost 20 years since it was first recorded. It is presumed that it was once planted there as an ornamental. However, it is now common and a dominant component of the vegetation along both sides of a 200 m section of track verge.

Extra Tasmanian distribution: SA, Vic.

Status: Sparingly naturalised

CLUSIACEAE

Hypericum humifusum L. (creeping St John's wort)

Specimen examined: Don River, Devonport (KIN), 9.i.1940, *A.M. Olsen s.n.* (HO 411728!).

Notes: This prostrate perennial herb is known in Tasmania from a single specimen collected more than 75 years ago and with scant notes. Baker (2005) regarded it as a taxon of uncertain status and concluded that surveys were required to determine its presence in Tasmania.

Extra Tasmanian distribution: Vic.

Status: Not naturalised

Hypericum pulchrum L. (slender St John's wort)

Specimens examined: Underwood, S slope of Browns Hill (BEL), 26.xii.1985, *A.M. Buchanan 7808* (HO!); Underwood, Ryans Road (BEL), 12.ii.2009, *M.L. Baker 1954* (HO!).

Notes: This of perennial herb is known in Tasmania from one small and highly localised population in the northeast of the State where it grows on a grassy roadside verge. It has persisted at the site for more than 30 years.

Extra Tasmanian distribution: None

Status: Sparingly naturalised

CORNACEAE

Griselinia littoralis (Raoul) Raoul (New Zealand broadleaf)

Specimens examined: Strahan, W side of Customs House (TWE), 1.xi.2005, *T. Rudman s.n.* (HO 535554!); Strahan, remnant forest behind Post Office (TWE), 21.xi.2005, *M.L. Baker 1670* (HO!); Strahan, Hogarth Falls Peoples Park (TWE), 21.xi.2005, *M.L. Baker 1666* (HO!); Royal Tasmanian Botanical Gardens, Hobart (cult.) (TSE), 13.i.2006, *M.L. Baker 1695* (HO!).

Notes: This evergreen shrub/small tree has a localised distribution in Tasmania, having only been collected from Strahan on the State's west coast. It occurs in disturbed sites throughout the town and on the edges of nearby remnant native forest. It is also cultivated in the area and this is the likely source of introduction. For a discussion of its distribution and habitat in Tasmania see Baker (2007).

Extra Tasmanian distribution: None

Status: Sparingly naturalised

CRASSULACEAE

Aeonium haworthii Salm-Dyck ex Webb & Berthel. (pinwheel)

Specimens examined: Tasman Island (TSE), 29.ix.2007, *P.A. Tyson 582* (HO!); Bellerive, coast side of Victoria Esplanade, SE of Abbott Street (TSE) 20.vi.2012, *D.E. Albrecht 14139* (HO!).

Notes: While there are only two formal collections of this shrubby succulent ornamental recorded from Tasmania, it is recognised that it is more widespread and merely poorly-collected in the State (as is the case for many succulent taxa due to technicalities in their preservation and curation). Notes on the Tasman Island collection indicate that it may have been successfully eliminated but this needs to be confirmed. The species is well-established at some coastal locations in southeast Tasmania, often forming large populations on steep, inaccessible cliffs.

Extra Tasmanian distribution: WA, SA, Vic.

Status: Naturalised

Crassula muscosa L. var. *muscosa* (clubmoss crassula)

Specimens examined: Midway Point, Tasman Highway (TSE), 31.iii.2006, *M.L. Baker 1706* (HO!); Second Bluff, Howrah (TSE), 12.xi.2009, *M. Wapstra 754* (HO!).

Notes: This low-growing succulent herb is represented by only two Tasmanian collections. However, it is recognised that it is more widespread but poorly-collected in the State. It was first recorded at Midway Point in the State's southeast, where it forms dense mats on a small section of roadside verge. At this site, it has presumably spread from deliberate ornamental plantings. The most recent record consists of a population growing in remnant native vegetation on a steep cliff near Bellerive Beach. Additional sites are known on North Bruny Island, where it is very well-established on sandstone cliffs, and near Cambridge on a grassy roadside batter.

Extra Tasmanian distribution: Vic.

Status: Sparingly naturalised

Crassula natans Thunb. var. *minus* (Eckl. & Zeyh.) G.D.Rowley (floating stonecrop)

Selected specimens examined (5 of 8): Flinders Island, Long Point (FLI), 17.viii.1975, *J.S. Whinray s.n.* (CANB 533240.1 [*n.v.*]); Nook Swamps, King Island (KIN), 19.xi.2007, *M. Wapstra 316* (HO!); Curries River Reservoir. Edge of water, W of picnic huts (BEL), 14.x.2008, *M. Wapstra 538* (HO!); Dartys Corner, S of Temma (KIN), 31.x.2008, *M. Wapstra 566* (HO!); Epping Forest, edge of car park of roadhouse, N end (TNM), 1.x.2014, *M. Wapstra 2030* (HO!).

Notes: This semi-aquatic annual appears to be a relatively recent arrival in Tasmania and is now widespread in mainly near-coastal sites. It is most often associated with ephemerally wet sites, usually in quite disturbed situations. Wapstra (2012) concluded that it was most likely "alien" based on the criteria of Bean (2007).

Extra Tasmanian distribution: WA, SA, Vic.

Status: Naturalised

Crassula tetragona L. subsp. *robusta* (Toelken) (Toelken miniature pine tree)

Specimen examined: Mt Nelson, edge of University Reserve (TSE), 20.i.2008, *A.M. Buchanan 16846* (HO!).

Notes: This succulent ornamental is known in Tasmania from a single collection from a single persistent population that has presumably escaped from a nearby garden where it has been deliberately planted. It is commonly planted in gardens and occurs on several roadside banks and verges, where it has persisted and slowly spread. It has been seen at numerous other sites (e.g. Bruny Island, Granton and St Helens). At present, it is considered sparingly naturalised due to the paucity of formal collections, but this is likely to change as its distribution is better understood.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Sparingly naturalised

CUCURBITACEAE

Ecballium elaterium (L.) A.Rich. (squirting cucumber)

Selected specimens examined (4 of 6): At football pitch crossroads, on W side of soccer field, Queens Domain (TSE), 17.iv.1984, *D.I. Morris 8419* (HO!); Between Tasman Bridge and Government House, Hobart (TSE), 10.viii.1999, *A.M. Buchanan 15466* (HO!); Hobart, between Tasman Highway and Intercity Cycleway in front of Government House (TSE), 6.ii.2014, *M.L. Baker 2856 and N.Gill* (HO!); Hobart, between Tasman Highway and Intercity Cycleway in front of Government House (TSE), 23.iii.2017, *M.L. Baker 3249* (HO!).

Notes: This prostrate perennial herb is locally established at The Queens Domain area in Hobart. It has been long-persistent at one site between the Tasman Bridge and the Cenotaph on a grassy highway verge, with only a single plant seen in 2017 after successful control measures reduced the number of plants in preceding years. The species has not been recorded at the upper Domain site since its initial collection and is now presumed to be absent there.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Sparingly naturalised

CUSCUTACEAE

Cuscuta suaveolens Ser. (fringed dodder)

Specimen examined: Paddock 6, Forthside Vegetable Research Station (TNS), 23.iv.1999, *Botanical Resources Australia s.n.* (HO 444804!).

Notes: This parasitic herb is known in Tasmania from a single collection that was growing with weeds in a red clover research plot in the northwest of the State. It was eradicated and has not been recorded since (DPIPWE 2014). See Figure 4.

Extra Tasmanian distribution: WA, NSW, Vic.

Status: Previously naturalised

ERICACEAE

Arbutus unedo L. (strawberry tree)

Selected specimens examined (5 of 6): "Lowana", King River Flats, SE of Strahan (TWE), 20.ii.1978, *R.C. Halton s.n.* (HO 540325!); Fern Tree, Hobart (cult.) (TSE), 11.iv.1988, *D.I. Morris 86323* (HO!); Legana, E side of Jetty Road (TNM), 14.vi.2007, *G. Stewart s.n.* (HO 545714!); Legana, Jetty Road (TNM), 29.xi.2011, *M.L. Baker 2614* (HO!); Rosebery, junction Lyell Highway and Hollywood Street (TWE), 24.v.2013, *M. Wapstra 1640* (HO!); Reid Street Reserve, Ulverstone (TNS), v.2014, *S. Stallbaum s.n.* (HO 579892!).

Notes: This ornamental tree is commonly cultivated in Tasmania but it is becoming naturalised. The population at Legana is comprised of several plants, naturalised in *Melaleuca ericifolia-Phragmites australis* wetland, and is thought to have spread from a mature tree in a nearby garden.

Extra Tasmanian distribution: SA, Vic.

Status: Sparingly naturalised

EUPHORBIACEAE

Euphorbia stricta L. (upright spurge)

Specimen examined: Bridport, Brid River walking track (FLI), 13.xi.2011, *M.L. Baker 2621* (HO!).

Notes: This annual herb is known in Tasmania from a single, localised population of mature plants and seedlings covering an area of 10 x 10 m on a disturbed river bank in Bridport on the State's north coast. The plants grow with various exotic herbs and grasses. The population was present when re-visited in November 2017 (M.L. Baker pers. obs.).

Extra Tasmanian distribution: None

Status: Sparingly naturalised

Figure 4. The parasitic herb *Cuscuta suaveolens* was recorded growing on weeds in a trial crop in Tasmania. Its discovery prompted a successful eradication program. Whilst it did not have the opportunity to form a self sustaining population, the potentially serious impacts of this species warrant it being listed as previously naturalised in Tasmania.

FABACEAE

Hedysarum coronarium L. (French honeysuckle)

Selected specimens examined (3 of 6): Hobart (cult.) (TSE), xii.1902, *L. Rodway 178* (HO!); Hobart (cult.)(TSE), i.1910, *L. Rodway 184* (HO!); Botanical Gardens, Hobart (cult.)(TSE), 24.xii.1946, *W.M. Curtis s.n.* (HO 10716!).

Notes: This short-lived perennial is known in Tasmania from several pre-1950 collections, all from cultivated specimens lacking informative notes. Curtis (1956) described its distribution and habitat as "introduced and persisting near centres of cultivation". From this scant information it is difficult to assign a naturalised status with any certainty. See Figure 5.

Extra Tasmanian distribution: Qld

Status: Not naturalised

Laburnum anagyroides Medik. (golden chain tree)

Specimens examined: Roadside, Neika (TSE), 12.ii.1997, *A.M. Buchanan 14409* (HO!); Cataract Gorge, Launceston (TNM), 14.x.2005, *M.L. Baker 1689* (HO!).

Notes: This small, deciduous ornamental tree is known in Tasmania from two disjunct locations. The most recent was from a population of naturalised plants growing on the sides of a steep dolerite gorge at Launceston. The species is occasionally seen growing on roadsides in southeast Tasmania (e.g. Taroona; below Queens Domain, Hobart), suggesting it is more widely naturalised than herbarium records indicate (M. Wapstra, pers. obs.).

Extra Tasmanian distribution: None

Status: Sparingly naturalised

Lathyrus nissolia L. (grass vetchling)

Specimens examined: D'Entrecasteaux Channel (TSE), ii.1904, *L. Rodway 176* (HO!); Gordon (TSE), 9.x.1924, *S.B. Barker s.n.* (MEL2298792A [*n.v.*]); Taroona Pathway off Oakleigh Avenue (TSE), 17.xi.2005, *D. Harris s.n.* (HO 539383!); Taroona, grass strip between Oakleigh Avenue and Cartwright Creek (TSE), 17.xi.2005, *M.L. Baker 1652* (HO!).

Notes: Despite being known only from a small number of discrete sites in southeast Tasmania, this annual herb has been present in Tasmania since at least 1904. The most recent collection was from a well-established population in an exotic grassland at Taroona in the south of the State. Curtis (1956) described its distribution and habitat as "rare, in grassy places".

Extra Tasmanian distribution: Vic.

Status: Sparingly naturalised

Lotus angustissimus L. (narrowleaf trefoil)

Specimens examined: Cressy House, Cressy (TNM), 17.iv.1985, *R.S. Smith s.n.* (HO 94684!); 5 km S of Wilmot on Cradle Mountain Rd (TNS), 13.iii.1995, *P.C. Jobson 3465* (NSW [*n.v.*]); Tonganah, site of former clay mine (BEL), 9.i.2002, *J. Findlay s.n.* (HO 518972!); Swansea, Rockcliffe property (TSE), 1.ii.2002, *A.M. Buchanan 15918* (HO!); Murphys Flat, Granton (TSE), 25.iii.2010, *M.L. Baker 2229* (HO!).

Notes: This annual sprawling herb is known in Tasmania from a small number of widespread records. It grows in range of situations, including croplands and wetlands. It is expected to be more common and widespread and has most likely been overlooked due to its close resemblance to other naturalised species of *Lotus* that occur in Tasmania.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Sparingly naturalised

Lupinus angustifolius L. (narrowleaf lupin)

Specimens examined: Eaglehawk Neck (TSE), 24.i.1928, *J.B. Cleland s.n.* (AD 966080625 [*n.v.*]); Sorell (TSE), 24.xi.1976, *D. Munro and N.Walker s.n.* (NSW 456562!); Bass Highway near Deloraine (TNM), 20.ix.2007, *M. Wapstra 226* (HO!); George Town/Bell Bay Road roundabout (FLI), 15.x.2008, *M. Wapstra 532* (HO!).

Notes: This annual herb is known in Tasmania from a small number of widespread collections. Curtis (1956) described its distribution and habitat as "cultivated in orchards as a green manure and found occasionally as an escape". However, no specimens were available to her at the time. More recently, it has been recorded as being prevalent on the verge of the Bass Highway (e.g. HO 547663) but is now absent there (M. Wapstra, pers. obs.). It appears to arise on road verges but not persist; for example, a single plant was collected near Epping Forest in 2004 (M. Wapstra, pers. obs.). It is cultivated in Tasmania as a grain legume for animal and human consumption (Knox *et al.* 2006).

Extra Tasmanian distribution: WA, NSW, Vic.

Status: Sparingly naturalised

Medicago arborea L. (tree medick)

Selected specimens examined (5 of 6): Killiecrankie Bay, Flinders Island (FLI), 28.vi.1966, *J.S. Whinray 37* (MEL1021317

Figure 5. *Hedysarum coronarium* is considered to be not naturalised in Tasmania as it appears that it is only known from cultivated specimens.

[*n.v.*]); Currie, King Island (KIN), 31.v.1984, *K. Harris s.n.* (HO 84377!); Lighthouse Street, King Island (KIN), 19.x.2008, *M. Batey s.n.* (HO 551270!); Currie, lighthouse street park (KIN), 24.ii.2009, *M.L. Baker 2018* (HO!); Tranmere foreshore (TSE), 24.x.2010, *M. Wapstra 1148* (HO!).

Notes: This small ornamental shrub has a disjunct distribution in Tasmania. It is restricted to coastal areas on Flinders Island and King Island, and at Tranmere on the shore of the River Derwent. All populations grow in the vicinity of gardens and can be found spreading into adjacent pasture, bushland and grasslands. The King Island populations are particularly well-established, albeit localised, with mature plants and seedlings present. This species is established in Tasmania but the small scale and number of sites suggest it should be considered only sparingly naturalised.

Extra Tasmanian distribution: Qld (doubtfully naturalised)

Status: Sparingly naturalised

Medicago sativa L. subsp. × *varia* (Martyn) Arcang. (=*Medicago falcata* auct. non L. sensu Curtis (1956))

Specimens examined: Bridgewater (TSE), 5.v.1945, *W.M. Curtis s.n.* (HO 42279!); Macquarie Plains (TSE), 16.ii.1969, *B. Davidson s.n.* (HO 536018!); Bridgewater, old railway yard at NW end of Bridgewater Bridge (TSE) 3.iv.2017, *M.L. Baker 3253* (HO!).

Notes: This hybrid perennial herb (*M. sativa* × *M. falcata*) is known in Tasmania from three collections. Recent reappraisal of two of these (previously identified as *M. falcata*) and of newly collected material shows that the plants are consistent with taxonomic delimitations of the hybrid taxon *M. sativa* subsp. × *varia* as proposed by Small (2011). No notes accompany the two earlier collections, but the most recent collection from a localised population at Bridgewater possibly represents the same site as one of the early records. Plants from this population exhibited a range of corolla colours, including white, yellow and pale to deep purple, while the plants were mostly prostrate to semi-prostrate in habit and had pods with 1.5 to 2 coils. Curtis (1956) stated that it is "found occasionally with *M. sativa*". *Medicago sativa* is common and widely naturalised in Tasmania. Whilst there is no evidence to suggest that *M. falcata* is naturalised in Tasmania, the hybrid taxon is locally naturalised at one location.

Extra Tasmanian distribution: None

Status: Sparingly naturalised

Onobrychis viciifolia Scop. (sainfoin)

Specimen examined: A little S of Melton Mowbray (TSE), 9.xi.1942, *H.D. Gordon s.n.* (HO 42235! & HO 11245!).

Notes: This perennial herb is known in Tasmania from a single specimen, collected more than 70 years ago, growing between a road and railway track in the Tasmanian Midlands agricultural area. No notes accompany the specimen to indicate its status at the collection site. Curtis (1956) described its habitat as "occasional near areas of cultivation". This statement is presumably based on this single record. The species may have been intentionally introduced as it is used as a fodder plant.

Extra Tasmanian distribution: NSW

Status: Not naturalised

Ornithopus sativus Brot. (French serradella)

Specimens examined: Waterhouse Road beyond Bridport (FLI), 24.x.1979, *M.P. Cameron s.n.* (HO 38953!); Mt Pleasant [Laboratories](TSE), 14.xii.1965, *G.M. Bendall s.n.* (HO 535746!); Low Head, area between Five Mile Bluff and Beechford (FLI), 29.xi.2011, *J. Davies s.n.* (HO 565095!).

Notes: This annual herb is known in Tasmania from two specimens from the northeast coast collected several decades apart, suggesting that it has possibly persisted in the region. The most recent collection is from agricultural land where it was locally common in a 500 x 200 m area. The 1979 collection was from a site where it had persisted from a pasture trial. It is occasionally used as a pasture species for its high nutritive value and ability to regenerate from seed.

Extra Tasmanian distribution: WA, NSW, Vic.

Status: Sparingly naturalised

Securigera varia (L.) Lassen (crown vetch)

Selected specimens examined (5 of 17): Near Botanical Gardens, [Hobart] (cult.), xi.1906, *L. Rodway s.n.* (HO 12313!); Railway Station, Botanic Gardens, [Hobart], i.1949, *L.A.S. Johnson s.n.* (NSW 642784 [*n.v.*]); Lutana, Hobart (cult.), 2.i.1985, *J.B. Davies s.n.* (HO 89327!); Domain Highway, adjacent to Royal Tasmanian Botanical Gardens, Hobart, 17.xii.2008, *M. Wapstra 631* (HO!); Hobart. Queens Domain - strip of remnant bushland between bicycle track and Lower Domain Road (all TSE), 14.x.2015, *M.L. Baker 3007 and A. Muyt* (HO!).

Notes: This perennial herb has a localised distribution in Tasmania centred around the Royal Tasmanian Botanical Gardens, Hobart, where it is locally naturalised on railway and roadside verges, and in remnant

woodland. It has been recorded as a cultivated plant at the Gardens and at several other locations in and around Hobart.

Extra Tasmanian distribution: NSW, ACT, Vic.

Status: Naturalised

Trifolium uniflorum L. (oneflower clover)

Specimen examined: Currie Airport, King Island (KIN), 17.xi.1976, *M. Allen s.n.* (HO 28028!).

Notes: This mat-forming perennial is known in Tasmania from a single collection from roadside gravel on King Island. The lack of collecting details and additional records since its collection more than 40 years ago suggest that it never became naturalised. Further searching in the vicinity of the collection is warranted.

Extra Tasmanian distribution: None

Status: Not naturalised

FUMARIACEAE

Fumaria officinalis L. subsp. *officinalis* (common fumitory)

Specimens examined: Georges Bay (FLI), vii.1875, *A. Simson 38* (HO!); Conara (TNM), 20.x.1925, *E. Gibson s.n.* (MEL2210067 [*n.v.*]); Hagley (TNM), 24.xi.1976, *D.I. Morris s.n.* (HO 96420!); Ulverstone (TNS), 10.i.1956, *B.R. Paterson s.n.* (NE 22397 [*n.v.*]); Sassafras, near Latrobe (TNS), 28.xii.1980, *B.H. Hyde-Wyatt s.n.* (HO 36985!).

Notes: This annual sprawling herb has been recorded as an occasional weed of crops in the north of the State but may be overlooked and mistaken for the widespread and common *Fumaria muralis* Sond. ex W.D.J.Koch subsp. *muralis*. A very early record (1875) from Georges Bay, St Helens, suggests that it was an early introduction.

Extra Tasmanian distribution: SA, Qld, NSW

Status: Doubtfully naturalised

Pseudofumaria alba (Mill.) Lidén subsp. *alba* (white fumitory)

Specimens examined: Old Customs House, lower Murray Street. Near Parliament House, Hobart, 15.xi.1961, *W.M. Blacklow s.n.* (HO 6545!); Fern Tree, Hobart (cult.), 4.xii.1986, *D.I. Morris 86141* (HO!); Fern Tree, Hobart, 19.ix.1989, *D.I. Morris 86402* (HO!); 9 Lapoinya Road, Fern Tree (all TSE), 28.xi.1994, *D.I. Morris 86456* (HO!).

Notes: This occasionally cultivated perennial herb is known in Tasmania only from the Hobart area, with an early (1961) collection from a crack in a wall of a domestic garden where it was noted as acting as a nuisance.

Extra Tasmanian distribution: NSW

Status: Not naturalised

GERANIACEAE

Erodium malacoides (L.) L'Hér. (oval heronsbill)

Specimens examined: Cataract Gorge, Launceston, 1.xi.1943, *W.M. Curtis s.n.* (HO 529453!); Cataract Gorge, Launceston (all TNM), 30.x.1945, *W.M. Curtis s.n.* (HO 29605! & HO 6668!).

Notes: Specimens of this annual herb have been collected in Tasmania on two separate occasions from Cataract Gorge, Launceston. Curtis (1956) described its distribution and habitat as "occasional in waste places". No notes detailing the status accompany the specimens and without subsequent collections in more than 70 years it is doubtful that the species has become naturalised.

Extra Tasmanian distribution: SA, NSW, Vic.

Status: Doubtfully naturalised

Geranium yeoi Aedo & Muñoz Garm. (Madeira cranesbill)

Selected specimens examined (5 of 7): Hobart Rivulet, 250 m downstream from Wynyard Street (TSE), 1.xi.2002, *A.M. Gray 1236* (HO!); 17 Keen Court, Kingston (TSE), 18.xi.2002, *D.I. Morris 86773* (HO!); Christmas Hills, Bass Highway (TNS), 2.xi.2004, *M. Baker 938 and M.F.Duretto* (HO!); Hobart, Romilly Street, just before bridge (TSE), 27.x.2009, *M. Wapstra 984* (HO!); S of Boronia Beach (TSE), 7.xi.2009, *M. Wapstra 1000* (HO!).

Notes: This erect biennial herb is locally abundant at several sites in the greater Hobart area. It is mainly associated with disturbed habitats such as roadside verges and banks of rivulets in urban areas. Weedy populations are presumed to be garden escapes or have arisen from dumped garden waste.

Extra Tasmanian distribution: Vic.

Status: Naturalised

LAMIACEAE

Mentha spicata L. (spearmint)

Selected specimens examined (5 of 9): Sandy Bay (TSE), i.1908, *L. Rodway s.n.* (HO 7312!); South Arm (TSE), 20.i.1912, *R.A. Black s.n.* (MEL2299781 [*n.v.*]); Mersey River at Croesus Cave State Reserve (TCH), 13.v.1983, *A. Moscal 2380*, (HO!); Black Bobs (TSR), 2.ii.1981, *A.E. Orchard 5341*, (HO!); New Town Rivulet (TSE), 10.ii.2008, *M. Wapstra 454*, (HO!).

Notes: This cultivated perennial herb is known in Tasmania from several disjunct locations. Curtis (1967) described its distribution and habitat as "naturalised in damp places", noting that "this species is the one [mint species] most commonly cultivated as a pot-herb". While it is a widespread species that has been present since at least 1908, it is usually only localised and grows mainly in riparian situations close to residential areas. Several populations have also been recorded in essentially undisturbed areas (e.g. Mersey River, Black Bobs).

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Sparingly naturalised

LENTIBULARIACEAE

Utricularia gibba L. (floating bladderwort)

Specimens examined: Wingara Road, Howden (TSE), 6.i.2012, *M.F. de Salas 109*, (HO!); Nabowla, 'Dunbarton', Bridport Back Road (BEL), v.2015, *L. Riggall s.n.* (HO 585568!).

Notes: This carnivorous herb is known in Tasmania from two disjunct locations. One collection, from Howden in the south of the State, was from an artificial garden pond. It was not intentionally cultivated there and it is thought to have been introduced as a contaminant, brought in with other ornamental plants in the pond. The Nabowla population was recorded growing in a dam/ornamental pond in a rural area of the State. The species is under-collected in Tasmania and has been observed in ponds and water features throughout the State (M. de Salas pers. comm.). It is considered native throughout mainland Australia but has never been recorded growing in natural habitats in Tasmania where it is not considered to be native.

Extra Tasmanian distribution: WA (native and naturalised), NT (native), SA, Qld (native), NSW (native), Vic. (native and naturalised)

Status: Doubtfully naturalised

MALVACEAE

Hibiscus trionum L. (bladder ketmia)

Selected specimens examined (5 of 9): Hobart, Royal Society Gardens (TSE), iv.1875, *W.W. Spicer s.n.* (HO 12950!); West Tamar (TNS), iii.1974, *T.T. Hague s.n.* (HO 30940!); 29 Brinsmead Road, Mt Nelson (TSE), 26.i.2006, *A.M. Buchanan 16399* (HO!); Sandfly, 202 Pelverata Road (TSR), 15.iv.2001, *J. Townrow s.n.* (HO 512128!); Norwood, 39 Norwood Avenue (TNM), iv.2008, *R. Hilder s.n.* (HO 547376!).

Notes: This annual herb is known in Tasmania from several widely-spread locations. Curtis and Morris (1975) described its distribution and habitat as "occasional as a weed of cultivation". All collections appear to be from gardens, either deliberately cultivated or arising as a contaminant of vegetable seeds. However, most collections are not accompanied by notes indicating the status. The species does not appear to have escaped the confines of gardens.

Extra Tasmanian distribution: WA, SA, Qld (native and naturalised), NSW (native and naturalised), Vic.

Status: Not naturalised

Malva pseudolavatera Webb & Berthel. (Cretan mallow)

Specimens examined: Currie, near Department of Agriculture, King Island, 29.x.1976, *D.I. Morris s.n.* (HO 36209!); Old Currie tip site, Charles Street, King Island, ix.2009, *M. Batey s.n.* (HO 556712!); Stanley, Stanley Highway, E side of road, c. 4.4 km from Bass Highway junction, 24.ix.2010, *M.L. Baker 2336* (HO!); Stanley, Stanley Highway, 25.x.2010, *K. Fenner s.n.* (HO 560413!); King Island, from airport, towards Currie and also north (all KIN) 9.xi.2010, *A. Fergusson s.n.* (HO 561569!).

Notes: This large biennial herb is known to occur in the northwest of the State (including King Island) where it is primarily a coloniser of roadside verges and is now well-established, often locally abundant, and appears to be becoming more widespread.

Extra Tasmanian distribution: WA, SA

Status: Naturalised

MIMOSACEAE

Acacia baileyana F. Muell. (Cootamundra wattle)

Selected specimens examined (4 of 8): Southern Outlet (A6 N bound) 3 km S of Proctors Saddle (TSE), 19.viii.2002, *A.M. Gray 1211* (HO!); Between Acton Road and Single Hill (TSE), 12.ii.2009, *M. Wapstra 658* (HO!); Snug Falls Road (O'Briens Road junction) (TSE), 26.ix.2009, *M. Wapstra 945* (HO!); Cethana Road. [Claude Road, Gowrie Park, c. 5 km E of Cethana.] (cult.?) (TNS), 22.xi.2012, *S. Pinzon-Navarro s.n.* (CANB 863868.1 [*n.v.*]).

Notes: This commonly cultivated ornamental shrub is known in Tasmania from several collections mostly from the southeast of the State. It is most commonly found naturalised along roadside verges, spreading from nearby ornamental and amenity plantings. Some sites, such as along the Southern Outlet, Hobart,

appear to have been deliberately planted, along with several additional non-native *Acacia* species. The first herbarium record in 2002 belies a much longer period of naturalisation, which probably began in earnest in the 1980s (based on the maturity of some stands).

Extra Tasmanian distribution: WA, SA, Qld, NSW (native and naturalised), ACT, Vic.

Status: Naturalised

ONAGRACEAE

Epilobium nummulariifolium A.Cunn. (creeping willowherb)

Specimens examined: Royal Botanic Gardens, Hobart, c. i.1999, [collector unknown] (HO 323677!); 3 Curtis Ave, South Hobart, 13.xi.2002, *A.M. Gray s.n.* (HO 520616!); Woodbank Nursery, 25.ii.2005, *M.L. Baker 1556* (HO!) (all TSE).

Notes: This mat-forming perennial herb is known in Tasmania from a few locations in the southeast of the State. There exists insufficient evidence for it to be classified as naturalised, with the species only being recorded from a domestic garden on the outskirts of Hobart, where it is restricted to the garden and the immediate surrounds, and from two nurseries: Royal Tasmanian Botanic Gardens, as a weed of a propagating area, and at Woodbank Nursery, where it was a weed in a pot plant and in a garden bed. At present, this species is doubtfully naturalised but it has high potential to become more widespread and naturalised throughout the State.

Extra Tasmanian distribution: None

Status: Doubtfully naturalised

Oenothera biennis L. (evening-primrose)

Specimens examined: Valleyfield, New Norfolk (TSE), 12.i.2001, *D.I. Morris 86729* (HO!); Valleyfield, New Norfolk (TSE), 28.ii.2001, *A.M. Buchanan 15856* (HO!); Bass Highway, 2 km E of Irishtown Road junction (KIN) 2.xi.2004, *M. Baker 936 and M.F.Duretto* (HO!); Scottsdale tip off Bridport Road, c. 200 m N of Jetsons Road junction (BEL), 11.i.2005, *M.L. Baker 1386* (HO!).

Notes: This ornamental biennial herb was first collected in Tasmania as a weed of a lily crop. There is increasing evidence that it is becoming naturalised in various regions, mainly around highly disturbed sites such as crops, rubbish tips and roadside verges.

Extra Tasmanian distribution: NSW

Status: Sparingly naturalised

PLUMBAGINACEAE

Limonium sinuatum (L.) Mill. (wavyleaf sea-lavender)

Specimens examined: Whitemark (FLI), 10.i.2007, *A.M. Buchanan 16568* (HO!); Scottsdale tip off Bridport Road, 200 m N of Jetsons Road junction (FLI), 11.i.2005, *M.L. Baker 1394* (HO!); Glenora Road, Glenora [Bushy Park] (TSE), 25.i.2013, *M. Wapstra 1516* (HO!); Anglican Cemetery, Sorell (end of Henry Street) (TSE), 5.ii.2013, *M. Wapstra 1537* (HO!).

Notes: This ornamental perennial herb is known in Tasmania from several widespread collections, mainly from highly disturbed sites such as tips and roadside verges. It appears to have arisen from dumped garden waste or as an escape from ornamental plantings (including cemeteries). It is popular in the florist trade due to the "everlasting" nature of the cut flowers.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Sparingly naturalised

POLEMONIACEAE

Collomia grandiflora Douglas ex Lindl. (grand collomia)

Specimen examined: King Island (KIN), vi.1957, *L. Smith s.n.* (HO 19628! & HO 317247!).

Notes: Curtis (1967) described the distribution and habitat of this annual herb as "occasional as a weed of cultivated land". No evidence supports this statement as the species is known in Tasmania from a single collection from a crop of potatoes on King Island sixty years ago—it has not been recorded since. Based on this evidence, the species cannot be considered naturalised to any degree in the State.

Extra Tasmanian distribution: NSW

Status: Not naturalised

PORTULACACEAE

Claytonia perfoliata Donn ex Willd. (miner's lettuce)

Specimens examined: Fern Tree, East Coast, Domestic garden [cult.], 4.i.1983, *D.I. Morris 8302* (HO!); Fern Tree, 6.i.1986, *D.I. Morris 862* (HO!); Woolton Court, Sandy Bay [Hobart suburb] (all TSE), 23.x.2009, *M.L. Baker 2105* (HO!).

Notes: This annual herb is known in Tasmania from a few collections from domestic gardens. One collection notes that it is "not invasive but behaving as a nuisance

weed in gardens, and in cracks in walls and pots". It is not known if the populations at the collection sites have persisted. The species is occasionally grown as a pot or garden bed herb and used in salads. It readily self-sows but has not appeared to have spread beyond domestic gardens.

Extra Tasmanian distribution: Vic.

Status: Not naturalised

PRIMULACEAE

Lysimachia minima (L.) U.Mans & Anderb. (kause chaffweed)

Specimens examined: Rubicon Sanctuary, Port Sorell (FLI), 14.x.2009, *P. Collier 5358* (HO!); Tinderbox, East Coast (TSE), 17.x.2011, *D.E. Albrecht s.n.* (HO!).

Notes: This diminutive annual herb is likely to be overlooked and much more widespread in Tasmania than indicated by current collections. Collections to date have been from a weedy habitat (Tinderbox) or as a single plant growing as a weed in a gravel drive. The species is widely naturalised on mainland Australia. A doubtfully naturalised status is assigned here pending further information on its distribution.

Extra Tasmanian distribution: WA, SA, NSW, ACT, Vic.

Status: Doubtfully naturalised

PROTEACEAE

Hakea laurina R.Br. (pincushion hakea)

Specimens examined: University of Tasmania gardens, Hobart (cult.), 12.iii.2002, *R. Dillon s.n. and G.Jordan* (HO 528995!); Coningham, 7.v.2005, *J. Taylor s.n.* (HO 541827!); Coningham, 21.x.2008, *R.G. Tyson 906* (HO!) (all TSE).

Notes: Apart from one collection from cultivation, this ornamental shrub is known in Tasmania from two specimens from the same site, collected approximately three years apart. Here, the species had most likely spread from nearby gardens (where it was noted as being present) into coastal heathy woodland, and occurred as a population of mature and young plants. The population was removed in 2008. The species is a popular garden plant in Tasmania and further naturalised populations are expected to occur. However, there is no evidence to suggest it is more widely naturalised.

Extra Tasmanian distribution: WA (native and naturalised), SA

Status: Previously naturalised

Lomatia fraseri R.Br. (tree lomatia)

Specimens examined: Pipeline Track, Fork Creek Catchment, Fern Tree, 12.iii.2002, *D. Ziegler 237* (HO!); Pipeline Track, Fern Tree, near Browns Road, 25.vi.2009, *P.A. Tyson 966* (HO!); Fern Tree, 30.vi.2009, *M.L. Baker 2098* (HO!); Mount Wellington, Pipeline Track 30.xi.2010, *M. Wapstra 1181* (HO!) (all TSE).

Notes: This shrub or small tree is known in Tasmania from several specimens from a single localised population comprised of several individuals and patches of plants growing in wet sclerophyll forest on the foothills of Mt Wellington in the State's southeast. There has been a concerted effort at removal by a local landcare group, but some individuals, presumably escaped from garden plantings, are still present. The species is native on mainland Australia, where it is a widespread and sometimes locally common species in wet mountain forests.

Extra Tasmanian distribution: NSW (native), Vic. (native)

Status: Sparingly naturalised

RANUNCULACEAE

Adonis microcarpa DC. (pheasant's eye)

Specimen examined: Flinders Island, Wybalenna area (FLI), 12.v.1999, *S. Welsh s.n.* (HO 444814!).

Notes: This erect annual herb has only been collected once in Tasmania, from a dry, sheep grazing paddock on Flinders Island. According to notes accompanying the specimen, the population consisted of approximately nine plants over an area of 30 m^2. A doubtfully naturalised status is assigned here pending further information on its distribution.

Extra Tasmanian distribution: WA, SA, Qld, NSW

Status: Doubtfully naturalised

Aquilegia vulgaris L. (common columbine)

Selected specimens examined (5 of 9): Poison Hill, 9 km E of Woodsdale (TSE), 6.x.1984, *A. Moscal 8517* (HO!); Poimena "township", Blue Tier (BEL), 28.xii.2006, *M. Wapstra 86* (HO!); Pipers River, downstream of Lilydale Road crossing (FLI), 18.xii.2007, *M. Wapstra 409* (HO!); North West Bay River (TSE), 7.xi.2000, *A.C. Rozefelds 1895* (HO!); River Road, N of Deloraine (TNS), 21.xi.2012, *M. Wapstra 1390* (HO!).

Notes: This commonly cultivated perennial herb is known in Tasmania from several widely spread populations. Most have been recorded from roadside verges or riparian zones, often in close proximity to

towns or old homesteads, presumably arising from dumped garden waste, persisting from old plantings or escaping from nearby gardens. Several coloured forms are present. The number of formal collections does not properly reflect its widespread and increasing range.

Extra Tasmanian distribution: NSW, Vic.

Status: Naturalised

Ranunculus acris L. subsp. *acris* (meadow buttercup)

Selected specimens examined (5 of 11): Electrona-Snug (TSE), 7.xii.1968, *W.M. Curtis s.n.* (HO 21139!); Saddle Road, Kettering (TSE), xi.1982, *Y. Menadue s.n.* (HO 91564!); Saddle Road, Kettering (TSE), 3.xi.1982, *Y. Menadue s.n.* (HO 58494!); Balfour, Circular Head (TWE), 12.xii.1983, *A. Moscal 4785* (HO!); Saddle Road, Kettering (TSE), 16.xi.2012, *M. Wapstra 1418* (HO!).

Notes: This erect perennial herb is locally naturalised in the Snug-Electrona-Kettering area in the State's southeast, where it has been present since at least the 1960s. It remains locally abundant at several sites in habitats that include roadside ditches and wet pastures. One outlying record is from clearings at the former settlement site of Balfour in the State's northwest, suggesting a potentially wider distribution. Curtis and Morris (1975) described the distribution and habitat as "southern Tasmania in a roadside ditch between Snug and Electrona".

Extra Tasmanian distribution: Vic.

Status: Naturalised

Ranunculus arvensis L. (field buttercup)

Specimen examined: Cressy (TNM), 2.i.1974, *B.H. Hyde-Wyatt s.n.* (HO 29167!).

Notes: This annual herb is known in Tasmania from a single record from Cressy in 1974. There are no accompanying notes to give any indication of the extent or status of the species at the location. As such, there is little evidence to indicate it has become naturalised in Tasmania. Curtis and Morris (1975) described the distribution and habitat as "an occasional weed of cultivation in the north", presumably based on the 1974 record from Cressy.

Extra Tasmanian distribution: SA, NSW

Status: Not naturalised

Ranunculus flammula L. subsp. *flammula* (lesser spearwort)

Selected specimens examined (3 of 6): Nabowla (BEL), 2.i.1980, *A.R. Walker s.n.* (HO 32340!); Nabowla [grown on from seed] (BEL), xi.1984, *A.R. Walker s.n.* (HO 88873!); Hobart (cult.) (TSE), 14.iii.1985, *Y. Menadue E37* (HO!).

Notes: This perennial herb is known in Tasmania from specimens collected in the northeast (Scottsdale and Nabowla) and subsequently from cultivated specimens collected from these locations. There is no collecting information regarding its status and it has not been collected for more than 30 years. As such, there is little evidence to indicate that it has become naturalised in Tasmania.

Extra Tasmanian distribution: Vic.

Status: Not naturalised

Ranunculus sceleratus L. subsp. *sceleratus* (celery buttercup)

Specimen examined: Hobart (TSE), *L. Rodway 10a* (HO!).

Notes: This annual or short-lived perennial herb is known in Tasmania from a single specimen. The undated collection (Leonard Rodway was Tasmania's honorary government botanist from 1896–1932) includes no notes regarding the plant's habitat or population details. It was listed in *The Tasmanian Flora* without any notes about its status (Rodway 1903). Its distribution and habitat were subsequently described by Curtis (1956) as "occasional in ditches", but no evidence exists to substantiate this comment. Based on the scant information it is difficult to justify that it was ever truly naturalised in Tasmania.

Extra Tasmanian distribution: SA, Qld, NSW, ACT, Vic.

Status: Not naturalised

Ranunculus trilobus Desf. (large annual buttercup)

Selected specimens examined (5 of 11): Fenton Forest, Gretna (TSE), 15.xi.1971, *D.I. Morris s.n.* (AD 123349!); Bushy Park (TSE), xii.1971, *D.I. Morris s.n.* (HO 29196!); Glenora (TSE), xii.1972, *D.I. Morris s.n.* (HO 29498!); Coastal strip between Richardson Point and Dartys Corner, S of Temma (KIN), 31.x.2008, *M. Wapstra 578* (HO!); Perth, Illawarra Road (TNM), 19.xi.2014, *M. Wapstra 2074* (HO!).

Notes: This annual herb is known in Tasmania from several widespread collections. Curtis and Morris (1975) described its distribution as "recorded only from Bushy Park, Derwent Valley", from where there are several specimens from the 1970s and 1980s, collected mainly from wet areas and ditches in farming areas. Since then

it has been found to be more widespread, including Cressy, in the State's midlands, and near Temma, on the State's west coast (the latter from a natural site and apparently unusual habitat for the species i.e. a coastal "marsupial lawn"). The species is also more widespread than indicated by formal collections, with additional populations being observed at Lillico Beach (FLI region) (M. Wapstra pers. obs.).

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Naturalised

ROSACEAE

Rubus philadelphicus Blanch. (Philadelphia blackberry)

Selected specimens examined (4 of 7): Eddie Ck, Piper's Brook Rd, 13.i.2000, *T. Rudman 27/4* (AD [*n.v.*]); Eddie Ck, 4 km W of Pipers River (town) on Bridport Rd, 10.ii.2000, *T. Rudman TRRB1* (AD [*n.v.*]); Piper's Brook, 28.iii.2005, *D.E. Symon s.n.* (AD 178729 [*n.v.*]); Pipers Brook, 22.x.2005, *D.E. Symon 17176* (AD [*n.v.*]) (all BEL).

Notes: This deciduous woody shrub, cultivated for its edible fruit, is locally naturalised in the Pipers River area in the State's northeast. It has also been recorded growing as a vigorously-suckering cultivated shrub at Forth in the State's northwest (Evans *et al.* 2007)

Extra Tasmanian distribution: NSW

Status: Naturalised

Rubus rubritinctus W.C.R.Watson (blackberry)

Selected specimens examined (5 of 6): Stoney Rise, Gov[ernment] Office Car Park, beside public carpark, Devonport (FLI), 8.i.2000, *T. Rudman 13* (AD [*n.v.*]); Geeveston tip area (TSR), 10.i.2000, *T. Rudman 22/2* (AD [*n.v.*]); George Town, Eddie Cr[ee]k, Piper's Brook R[oa]d (BEL), 13.i.2000, *T. Rudman 27/8* (AD [*n.v.*]); Lilydale Road (BEL), 13.i.2000, *T. Rudman 30/1* (AD [*n.v.*]): Walpole Street, Franklin, Huon Valley (TSR), 2.iii.2007, *K.J. Evans 107* (HO!).

Notes: This sprawling perennial shrub is known in Tasmania from several disjunct locations including the northeast, central north, and south of the State. This taxon was previously included within the widespread and common *R. fruticosus* L. species-aggregate, a name that served as a catch-all for all weedy blackberry in Australia. The aggregate was revised by Evans *et al.* (2007), who found it to include *R. rubritinctus*. The species may have been overlooked in Tasmania due to its similarity with other taxa related to *R. fruticosus*.

Extra Tasmanian distribution: SA

Status: Naturalised

Rubus rugosus Sm. (keriberry)

Selected specimens examined (5 of 9): 61a Salvator Road, West Hobart (cult.) (TSE), *J. Chraska s.n.* (HO 30552!); Coronation Road off Fortescue Bay Road (TSE), 15.iv.1976, *A.M. Gray s.n.* (HO 7440!); Smithton (KIN), 27.iv.1977, *J.W. Lees s.n.* (HO 569508!); Elliott (cult.) (TNS), 10.i.1984, *P.A. Regel s.n.* (HO 76701!); Arthur Highway, c. 1.2 km W Eaglehawk Neck/Blowhole Road (TSE), 8.v.2013, *M. Wapstra 162,* (HO!).

Notes: This sprawling perennial shrub is grown in Tasmania for its edible berries. It is known from several cultivated specimens from domestic gardens and hedges. In addition, there are several widespread but localised collections of non-cultivated plants that were growing in waterways and bushland.

Extra Tasmanian distribution: NSW, Vic.

Status: Sparingly naturalised

RUBIACEAE

Galium tricornutum Dandy (rough corn bedstraw)

Specimens examined: Unknown [Hj.?] *Eichler 17044* (CANB 803049.1 [*n.v.*]); Sandy Bay, Hobart (TSE), xii.1896, *L. Rodway s.n.* (HO 512698!); Hobart Domain (TSE), [collector unknown] (MEL2098143 [*n.v.*]).

Notes: This annual sprawling herb is known in Tasmania from three specimens. Two were collected from the Hobart area, whilst the location of the third is unknown (Thompson 2009). No information regarding the plant's habitat, abundance or degree of naturalisation are recorded.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Not naturalised

Galium verum L. (yellow bedstraw)

Specimens examined: Corner of Dairy Plains and Cheshunt Roads. (TNS), 10.i.2000, *A.M. Buchanan 15656* (HO!); Corner of Harwood Road and Dairy Plains Road (TNS), 1.ii.2008, *A.M. Buchanan 16852* (HO!).

Notes: This stoloniferous perennial herb is known from two specimens collected from the same general vicinity, where it was described as naturalised along a short stretch of grassy roadside (Thompson 2009). The species has persisted at the site throughout the 2000s.

Extra Tasmanian distribution: Vic. (formerly naturalised)

Status: Sparingly naturalised

SALICACEAE

Salix alba L. var. *vitellina* (L.) Stokes (golden upright willow)

Selected specimens examined (5 of 17): St Peters Pass (ca 5 km NE of Oatlands) (TSE), 22.ix.1976, *W.M. Curtis s.n.* (HO 36157!); Penguin-old highway (cult.)(TNS), 31.x.2003, *M.L. Baker 249* (HO!); Riverside, Launceston (TNM), 1.xi.2003, *M.L. Baker 281* (HO!); 16.4 km from Bridport on Waterhouse Road, Deep Water property (FLI), 11.i.2005, *M.L. Baker 1310 and A.Gray* (HO!); Kooyong Glen, Dynnyrne (cult.?) (TSE), 9.xii.2010, *J. Gouldthorpe 11* (HO!).

Notes: This deciduous ornamental tree is widely cultivated throughout the State and is often encountered growing on roadsides, the sides of watercourses and ponds, and in large parks and gardens. In almost all instances it appears to have been planted, and only a small number of plants have been observed where their origin may have resulted from vegetative spread from nearby trees. For a comprehensive discussion of this taxon's distribution and status in Tasmania see Baker (2009).

Extra Tasmanian distribution: SA, NSW, ACT, Vic

Status: Doubtfully naturalised

Salix × *calodendron* Wimm. (holme willow)

Specimens examined: Queenstown, bank of Queen River (TWE), 13.ix.2006, *M.L. Baker 1728* (HO!); Coombes Road, Longley, (cult.?) (TSE), 22.xi.2006, *M.L. Baker 1771* (HO!).

Notes: This deciduous ornamental tree is known in Tasmania from two disjunct and localised populations. In both cases the plants appear to have been planted, with only the population at Queenstown showing signs of minor vegetative spread. For a comprehensive discussion of this taxon's distribution and status in Tasmania see Baker (2009).

Extra Tasmanian distribution: SA, NSW

Status: Doubtfully naturalised

Salix matsudana Koidz. 'Tortuosa' (tortured willow)

Selected specimens examined (5 of 11): Rosny Golf Course (cult.) (TSE), 30.iv.2003, *M.L. Baker 104* (HO!); Deloraine, Rotary Caravan Park, Deloraine (cult.)(TNM), 30.x.2003, *M.L. Baker 230* (HO!); SW Roseberry, waste transfer station (TWE), 15.ix.2004, *M.L. Baker 568* (HO!); Pioneer (BEL), 11.i.2005, *M.L. Baker 1363* (HO!); Lauderdale, between houses and the 'Lauderdale' wetland, (cult.?) (TSE), 24.i.2013, *M. Wapstra 1512* (HO!).

Notes: This deciduous ornamental tree is widely cultivated throughout Tasmania. In the majority of cases, the trees appear to have been planted, with only a small number of individuals or small groups of trees found growing outside of cultivation in habitats such as municipal rubbish tips. A small infestation of plants of hybrid parentage (*S. matsudana* Koidz. 'Tortuosa' and *S.* × *fragilis* L. nothovar. *fragilis*) was recorded at Huonville. For a comprehensive discussion of this taxon's distribution and status in Tasmania see Baker (2009). A large infestation of hybrid willows at Launceston, in the State's north, was recently observed, with some plants showing the twisted leaves and stems that are characteristic of the tortured willow, suggesting that *S. matsudana* Koidz. 'Tortuosa' is a parent.

Extra Tasmanian distribution: NSW, Vic.

Status: Doubtfully naturalised

Salix purpurea L. (purple osier)

Specimens examined: Royal Tasmanian Botanical Gardens (cult.) (TSE), 4.iii.2004, *M.L. Baker 389* (HO!); Oldina picnic area/forest reserve (TNS), 3.xi.2004, *M.L. Baker 989* (HO!); Just below Winkleigh Bridge (TNS), ii.2005, *M. Askey-Doran s.n.* (HO 532975!).

Notes: This deciduous ornamental shrub has been cultivated in Tasmania for stream bank stabilisation purposes and as an ornamental. Whether it is naturalised in Tasmania or whether all plants have been planted is unknown. For example, at the Oldina Forest Reserve in the northwest of the State, approximately 400 m of creek line is dominated by *S. purpurea*. It was originally planted at this site but it is not known the extent of the planting or if vegetative spread has occurred. For a comprehensive discussion of its distribution and status in Tasmania see Baker (2009).

Extra Tasmanian distribution: NSW, Vic.

Status: Sparingly naturalised

Salix × *rubens* Schrank (basket willow)

Selected specimens examined (5 of 7): Nelson River, on Lyell Highway, 10 km east-southeast of Gormanston (TWE), 13.xi.1980, *B. Briggs 7084* (NSW 393768 [*n.v.*]); Kingborough Refuse Centre (TSE), 30.iv.2003, *M.L. Baker 106* (HO 532977!); Kingborough Refuse Centre (TSE), 20.i.2004, *M.L. Baker 364* (HO 525024!); Faggs Gully Creek, Geilston Bay (TSE), 17.ii.2004, *M.L. Baker 378* (HO 525022!); Westerway, banks of Tyenna River (TSE), 16.ii.2005, *M.L. Baker 1535 A. Crane and E. Pope,* (HO 532972!).

Notes: This deciduous ornamental tree is occasionally cultivated in Tasmania. It is known from one small population where it is thought to have spread via vegetative means. The taxon may be more widespread as it is easily confused with the common and widespread *S.* ×*fragilis* nothovar. *fragilis* and *S. alba* var. *vitellina*. At Westerway, *S.* ×*fragilis* nothovar. *fragilis* and *S. alba* var. *vitellina* are thought to have hybridised, producing young plants referable to *S.* ×*rubens*. For a comprehensive discussion of this taxon's distribution and status in Tasmania see Baker (2009).

Extra Tasmanian distribution: SA, NSW, ACT, Vic

Status: Doubtfully naturalised

Salix × *sepulcralis* Simonk. nothovar. *chrysocoma* (Dode) Meikle (golden weeping willow)

Selected specimens examined (5 of 15): Melton Mowbray (TSE), 21.ix.1976, *W.M. Curtis s.n.* (HO 36158!); Huonville, Apex Park, (cult.) (TSR), 21.x.2003, *M.L. Baker 172* (HO!); Campbell Town, Elizabeth River (cult.) (TNM), 30.x.2003, *M.L. Baker 216* (HO!); Emu River, pumphouse area, Burnie (TNS), 31.x.2003*M.L. Baker 248*, (HO!); 4.9 km W of Bridport on the Bridport/George Town Road (cult.) (FLI), 12.i.2005, *M.L. Baker 1420* (HO!).

Notes: This deciduous ornamental tree is widely cultivated throughout the State and is often encountered on roadsides, the sides of watercourses and ponds, and in large parks and gardens. In almost all instances, it appears to have been planted and only a small number of plants have been observed where their origin may have resulted from vegetative spread from nearby trees. For a comprehensive discussion of this taxon's distribution and status in Tasmania see Baker (2009).

Extra Tasmanian distribution: NSW, Vic.

Status: Doubtfully naturalised

SCROPHULARIACEAE

Antirrhinum majus L. (snapdragon)

Selected specimens examined (5 of 8): George Town Waste Transfer Station (tip) off Mount George Road (FLI), 12.i.2005, *M.L. Baker 1442* (HO!); Launceston tip, Remount Road, near Newham Creek (TNM), 1.ii.2005, *M.L. Baker 1524* (HO!); Flinders Island, Whitemark Tip site off Memana Road (FLI), 17.v.2011, *M.L. Baker 2562* (HO!); Tasman Highway, near Cambridge (TSE), 22.xi.2011, *M. Wapstra 1315* (HO!); Lyell Highway, just W of Granton and Bridgewater Causeway (TSE), 1.v.2013, *M. Wapstra 1627* (HO!).

Notes: This perennial herb is known in Tasmania from seven widespread collections. In most cases no more than two plants have been recorded at each of the sites. However, at one suburban site in Hobart, it was noted as being 'occasional'. There is no evidence that plants have persisted at these sites.

Extra Tasmanian distribution: None

Status: Sparingly naturalised

Kickxia spuria (L.) Dumort. subsp. *integrifolia* (Brot.) R.Fern. (bluntleaf toadflax)

Specimens examined: Rifle Range, Sandy Bay, Hobart (TSE), *R.A. Black s.n.* (MEL2095212 [*n.v.*]); Westbury (TNM), ii.1943, *J.H. Wilson s.n.* (HO 411601!); Selbourne Road, Hagley (TNM), 18.ii.2000, *M. Greenhill s.n.* (HO 502751!).

Notes: This perennial herb is known in Tasmania from three widespread locations. Curtis (1967) described the distribution and habitat as "occasional as a weed of cultivation". Two of the specimens are noted as being weeds of crops, with one growing in a flax crop and the other being widespread and sporadic in a pyrethrum crop. No evidence exists to suggest that it has persisted at any of the sites.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Doubtfully naturalised

Veronica peregrina L. (wandering speedwell)

Specimens examined: V.D.L. [Van Diemensland], *F. Mueller s.n.* (MEL2256541!); Woodhall. South Esk Riv[er]. Van Diemensland (TNM), i.1849, *C. Stuart 459,* (MEL!).

Notes: This annual herb is known in Tasmania from two collections from more than 150 years ago. Inspection of these revealed that they are almost certainly duplicates of each other. Curtis (1967) described its distribution and habitat in Tasmania as "occasional in cultivated ground". However, there is no evidence to support this statement. No information regarding its habitat, abundance and degree of naturalisation are recorded with the specimens. For a discussion of this species in Tasmania see Baker (2016).

Extra Tasmanian distribution: SA, NSW, ACT, Vic.

Status: Not naturalised

SOLANACEAE

Hyoscyamus albus L. (white henbane)

Specimen examined: Near Hobart Town (TSE), xii.1876, *W.W. Spicer 121* (HO!).

Notes: This annual or short-lived perennial herb is known in Tasmania from a single specimen collected more than 140 years ago. It is listed in Spicer's *A Handbook of the Tasmanian Plants* (Spicer 1878b as *H. niger*) as introduced but not widely established enough to consider it being part of the flora. Curtis (1967) described its distribution and habitat as "occasional as a weed of cultivation". No information regarding its habitat, abundance and degree of naturalisation are recorded and there is little evidence to indicate that it was ever naturalised in Tasmania. See Figure 6.

Extra Tasmanian distribution: Vic.

Status: Not naturalised

Nicotiana sylvestris Speg. (woodland tobacco)

Specimens examined: 61a Salvator Road, West Hobart (cult.) (TSE), *J. Chraska s.n.* (HO 30551!); Stieglitz Tip, St Helens (FLI), 13.ii.2009, *M.L. Baker 1970* (HO!).

Notes: This annual or short-lived perennial herb is occasionally cultivated as an ornamental garden plant in the State. It has been recorded outside of cultivation at a disused tip-site on the east coast where it has presumably arisen from dumped garden waste.

Extra Tasmanian distribution: None

Status: Not naturalised

Physalis peruviana L. (Cape gooseberry)

Selected specimens examined (5 of 11): Boat Harbour, Wynyard area (KIN), 17.i.1975, *B. Copley 4667* (AD 97508260 [*n.v.*]); Suburban garden, Blackmans Bay (TSE), 18.v.1985, *P.A. Collier 534* (HO!); Great Dog Island (cult.) (FLI), 8.xii.1986, *S. Harris s.n.* (HO 123909!); Huonville, S side of river (TSR), 16.ii.2006, *A.M. Buchanan 16407* (HO!); Lovers Lane, Naracoopa, King Island (KIN), 26.i.2015, *M. Batey 436 and G. Batey* (HO!).

Notes: This short-lived shrub is occasionally cultivated in Tasmania as an ornamental and for its edible fruit. Outside of cultivation it is known from several disjunct locations from weedy habitats, including roadsides, tip sites, vegetable gardens and agricultural land, but occasionally also in relatively undisturbed bushland. Populations are usually restricted to small numbers of plants and are thought to have originated from dumped garden waste or spread via animals.

Extra Tasmanian distribution: WA, SA, Qld, NSW, Vic.

Status: Naturalised

Solanum nodiflorum Jacq. (small-flowered nightshade)

Specimen examined: Clarence Point, West Tamar (FLI), 28.ix.1993, *A.M. Buchanan 13453* (HO!).

Notes: This annual or short-lived perennial herb is known in Tasmania from a single collection made in 1993 from disturbed ground at the edge of a *Eucalyptus* forest in the north of the State. No information regarding the plant's abundance and degree of naturalisation are recorded, making it difficult to assign any naturalised status. It may be mistaken for the widespread and commonly naturalised *Solanum nigrum* L.

Extra Tasmanian distribution: WA, NT, Qld (?native and naturalised), NSW (?native and naturalised), Vic.

Status: Doubtfully naturalised

Solanum triflorum Nutt. (cutleaf nightshade)

Selected specimens examined (5 of 7): Seven Mile Beach, 3.iv.2000, *A.M. Buchanan 15695* (HO!); Pitt Water, Pittwater Road, 8.i.2004, *T. Swan s.n.* (HO 527944!); Service Depot, Five Mile Beach, 10.iii.2006, *A. Crane s.n.* (HO 539022!); Tasman Highway, Tunnel Hill section, E side, 9.vi.2010, *M. Wapstra 1115* (HO!); 533 Pass Road, Mornington, 11.iv.2011, *M. Moore s.n.* (HO 562180!) (all TSE).

Notes: This annual herb is known in Tasmania from a small number of localised but well-established populations in the State's southeast. It is most often recorded growing in sandy soils at low elevations.

Extra Tasmanian distribution: WA, SA, NSW, ACT, Vic.

Status: Naturalised

URTICACEAE

Parietaria judaica L. (wall pellitory)

Selected specimens examined (4 of 6): 17 Keen Court, Kingston, 7.i.1998, *D.I. Morris 86648* (HO!); 11 Carr Street, North Hobart, 30.vi.2008, *M.L. Baker 1890* (HO!); lower side (private car park), Bathurst Street, Hobart, 30.xi.2012, *M. Wapstra s.n.* (HO 568271!); Hobart, corner of Collins Street and Barrack Street 18.ix.2015, *M.L. Baker 3012* (HO!) (all TSE).

Notes: This perennial herb is known in Tasmania from a small number of specimens from the State's southeast. It has been recorded as a weed in two gardens and as single plants growing from the cracks of walls and footpaths.

Extra Tasmanian distribution: WA, SA, Qld, NSW, Vic.

Status: Doubtfully naturalised

Figure 6. This is the only collection of *Hyoscyamus albus* from Tasmania. Without contextual collecting information, it cannot be used as evidence to assign a naturalised status.

Gymnospermae

PINACEAE

Pinus wallichiana A.B.Jacks. (Bhutan pine)

Specimen examined: Trevallyn Cataract Gorge, track on N side of South Esk River between First Basin and Kings Bridge, 13.ii.2009, *M.L. Baker 1974* (HO!); Cataract Gorge, track from Kings Bridge to Gorge (all TNM), 8.xi.2017, *M.L. Baker 3393* (HO!).

Notes: This evergreen conifer is known in Tasmania from a single localised population at Launceston's Cataract Gorge. The population consists of several plants that have most likely spread from nearby cultivated plants and includes mature and juvenile plants.

Extra Tasmanian distribution: None

Status: Sparingly naturalised

Monocotyledoneae

ALOEACEAE

Kniphofia uvaria (L.) Oken (red-hot poker)

Specimens examined: Balfour (TWE), 12.xii.1984, *A. Moscal 4783* (HO!); Tamar Cut (W of track) (TNM), 18.i.2009, *M. Wapstra 629* (HO!); Gowrie Park, near Wilderness Village (TNS), 14.iii.2010, *L.H. Cave, 1098* (HO!); Junction Arthur Highway and Kellevie Road (TSE), 21.xi.2010, *M. Wapstra 1178* (HO!); Encampment Cove, Kintail home site, Maria Island (TSE), 8.iii.2011, *M.L. Baker 2368* (HO!).

Notes: This tufted perennial herb is widely cultivated throughout the State as a garden and amenity plant. It has become naturalised to varying degrees at several locations with populations ranging in size from single clumps through to numerous individuals. It is most often seen growing on roadsides and bushland adjacent to urban areas, where it has escaped cultivation or arisen from dumped garden refuse. A particularly large population, in excess of 250 plants, was recently observed at Mt Nelson in the State's south, growing in a remnant bushland reserve (A. Muyt pers. comm.). See Figure 7.

Extra Tasmanian distribution: NSW, Vic.

Status: Naturalised

CYPERACEAE

Carex buxbaumii Wahlenb. (club sedge)

Specimens examined: Western Mountains [Western Tiers] (?TCH), xii.1908, *L. Rodway s.n.* (HO 97156!); Near Bronte Lagoon (TSR), 23.xi.2004, *A.J. North s.n.* (HO 533230!).

Notes: This rhizomatous sedge is known in Tasmania from two collections. No information regarding its abundance and degree of naturalisation are recorded although the most recent one notes that the plants were growing in damp native grassland. Due to the lack of notes accompanying the specimens it is difficult to determine its status in Tasmania.

Extra Tasmanian distribution: NSW

Status: Doubtfully naturalised

Carex pilulifera L. (pill sedge)

Specimen examined: Lynchford, Queenstown (TWE), 15.xii.1994, *A.J. North s.n.* (HO 410951!).

Notes: This densely tufted perennial sedge is known in Tasmania from a single specimen, collected more than 20 years ago from a small population growing along a tramline at Lynchford on the State's west coast. It is not known if the species is still present at the site.

Extra Tasmanian distribution: None

Status: Doubtfully naturalised

Carex scoparia Schkur. ex Willd. (broom sedge)

Specimen examined: Arthur River at Kanunnah Bridge (KIN), 23.xii.1983, *A. Moscal 5179* (HO!).

Notes: This perennial sedge is known in Tasmania from a single specimen, collected from the Arthur River crossing at the Trowutta Forest Reserve. Notes regarding the species at the site indicate that it was a rare coloniser of alluvial sand. It has not been recorded for more than 30 years and is considered doubtfully naturalised due to the highly dynamic nature of its habitat.

Extra Tasmanian distribution: None

Status: Doubtfully naturalised

Carex testacea Sol. ex Boott (orange sedge)

Specimens examined: Intersection of Brooker Highway and Burnett Street, Hobart (cult.), 23.i.1987, *A.M. Buchanan 9870* (HO!); Princes Park, Hobart (cult.), 25.v.1988, *W.M. Curtis s.n.* (HO 327899!); Brooker Highway at Burnett Street, Hobart (cult.), 9.vi.1989, *W.R. Watson s.n.* (HO 114902!); Tasmania (cult.), 30.xi.2002, *A. Crane s.n.* (HO 520296!); Sandy Bay, track at end of Marlborough Street. Hobart 5.xii.2007, *M.L. Baker 1853* (HO!) (all TSE).

Notes: This tufted perennial sedge is known in Tasmania from five collections, all from the Hobart

TASMANIAN HERBARIUM HOBART HO: 554945
Kniphofia uvaria (L.) Oken
DET: M.L.Baker 20 May 2010
TASMANIAN HERBARIUM (HO)
Tasmanian Herbarium HO 554945
Hobart
Flora of Tasmania
Central Highlands Region
ALOEACEAE
Kniphofia uvaria (L.) Oken
Gowrie Park, near Wilderness Village
41° 28' 17.0" S 146° 12' 55.0" E
Grid: MGA94 FOT 434477 5408614
Precision: 1 Altitude: 290 m.
L.H. Cave 1098 14 Mar 2010
Former house site, now with 10m-tall Acacia dealbata and Pinus radiata, with weeds underneath
Notes: Many plants spreading across vacant land. GPS accuracy: ±12m
Dupl. ex: Dupl. sent to: MEL
0 1 2 3 4 5 6 7 8 9 10
cm
copyright reserved
Tasmanian Museum & Art Gallery
LHC 1698

Figure 7. Recent collections of *Kniphofia uvaria* have shown that it has become naturalised and occurs in several populations in Tasmania. This is an example of a species that does not lend itself to easy collection or curation, so it is probably under-represented in the formal collection at the Tasmanian Herbarium.

area. All but a single plant were collected from ornamental plantings or cultivated specimens. The only non-cultivated specimen was from a single plant growing on the side of a track in a recently developed bushland remnant. Curtis and Morris (1994) listed it in their flora and stated that it "...could become invasive". Little evidence exists to suggest that it is naturalised in Tasmania.

Extra Tasmanian distribution: None

Status: Not naturalised

Isolepis hystrix (Thunb.) Nees (awned clubsedge)

Selected specimens examined (4 of 9): Powranna Main Road, close to gateway of Hummocky Hills track (TNM), 15.xi.1996, *A.J. North s.n.* (HO 322628!); Freshwater soak just W of Calverts Lagoon, South Arm (TSE), 20.xii.2005, *M. Visoiu 120* (HO!); Between George Town and Bell Bay (FLI), 30.x.2006, *J.B. Davies s.n.* (HO 542926!); Perth, Illawarra Road, S side (TNM), 19.xi.2014, *M. Wapstra* 2075 (HO!).

Notes: This annual sedge, although only detected as late as 1996, is now known to be locally common and widely distributed in Tasmania. It is associated with roadside drains, freshwater (and sometimes slightly saline) lagoons, herb fields and other moist disturbed sites. Although it is highly distinctive, its ephemeral habit and small size have possibly led to it being overlooked at other similar habitats and locations.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Naturalised

HAEMODORACEAE

Anigozanthos flavidus Redouté (evergreen kangaroo paw)

Specimens examined: Binalong Bay Road, Binalong Bay (FLI), 1.viii.1975, *J. Robin s.n.* (HO 327793!); Creek, 0.8-1 km N of Binalong Bay (FLI), 5.i.2006, *M.F. Duretto 2074* (HO!); Paddocks adjacent to the Postmans Track Pass (KIN), 23.ii.2005, *P. Hefferon s.n.* (HO 536135!); Binalong Bay, Grants Point Road (cult.?) (FLI), 13.ii.2009, *M.L. Baker 1962* (HO!).

Notes: This rhizomatous perennial herb is widely cultivated in Tasmania and is known from several collections that appear to be derived from nearby garden plantings. At one location, numerous plants were recorded as escaping from cultivation and growing on the fringe of the Rocky Cape National Park.

Extra Tasmanian distribution: WA (native), NSW

Status: Sparingly naturalised

HYDROCHARITACEAE

Lagarosiphon major (Ridl.) Moss (oxygen weed)

Specimen examined: Royal Botanic Gardens, Hobart (cult.?) (TSE), 24.v.1983, *D.I. Morris 8350* (HO!).

Notes: This rhizomatous aquatic perennial herb is known in Tasmania from a single, possibly cultivated, specimen from a pond at the Royal Tasmanian Botanical Gardens (Hobart). There is no evidence that it has persisted or spread from the site.

Extra Tasmanian distribution: NSW (doubtfully naturalised)

Status: Not naturalised

IRIDACEAE

Tritonia gladiolaris (Lam.) Goldblatt & J.C.Manning (chiffon lace)

Specimens examined: S[outh] of Murdunna (TSE), 19.x.1973, *W.M. Curtis s.n.* (HO 58867!); Railton area, S of Dulverton Hill Road (TNS), 22.xi.2013, *M. Wapstra 1396* (HO!); Arthur Highway [just WNW of Flinders Bay Road junction] (TSE), 18.x.2013, *M. Wapstra 1474* (HO!).

Notes: This perennial herb is known in Tasmania from two widely separated locations. Curtis and Morris (1994) described its distribution and habitat, based on a 1973 collection (as *Tritonia lineata* (Salisb.) Ker Gawl.), as "introduced, recorded only from a sandy bank in light Eucalypt forest at Murdunna (East Coast), apparently well-established". It was recently collected from (presumably) the same site and described as growing in several dense patches along an 80 m section of roadside verge. It has been detected at one additional site in the north of the State, where it was growing on a road reserve adjacent to dry eucalypt forest.

Extra Tasmanian distribution: WA, SA, Qld, NSW, ACT, Vic.

Status: Sparingly naturalised

JUNCACEAE

Juncus microcephalus Kunth (smallhead rush)

Selected specimens examined (3 of 4): S[outh] bank of North Esk River, Launceston, just upstream from Charles Street Bridge, ii.1981, *B. Robinson s.n.* (NSW 225669 [*n.v.*]); Bass

Highway, near Prospect, Launceston, 30.x.2000, *K. Graham s.n.* (HO 533225!); Bass Highway, near Prospect, Launceston (all TNM), 20.vii.2005, *M.L. Baker 1588*, (HO!).

Notes: This tufted perennial is known in Tasmania from two locations in the Launceston area. Curtis and Morris (1994) described its distribution and habitat as "local, recorded from marshes in two localities in the North West". However, there is no evidence to support this. It was more recently collected from near Prospect (Launceston) where it is locally abundant and persistent on a highway verge covering an area of approx. 30 × 5 m.

Extra Tasmanian distribution: WA, Qld, NSW, Vic.

Status: Sparingly naturalised

LILIACEAE

Alstroemeria aurea Graham (Peruvian lily)

Specimens examined: Waratah Cemetery (TCH), 2.ii.2001, *A.M. Buchanan 15838* (HO!); 15 m from corner of Huon Road and Ridgeway Road (TSE), 4.i.2004, *M.F. Duretto 1672* (HO!); Haldane Reserve, Lenah Valley (TSE), 2.iii.2011, *M. Wapstra 1232* (HO!); Old town of Guildford (TCH), 2.ii.2014, *M. Wapstra 1814* (HO!).

Notes: This tuberous perennial is commonly cultivated as a garden plant in Tasmania. It appears to be naturalised in scattered localities where it forms small, localised patches. One record notes that it is naturalising in a paddock but does not indicate the extent of the population.

Extra Tasmanian distribution: NSW, Vic.

Status: Sparingly naturalised

Scilla peruviana L. (Cuban lily)

Selected specimens examined (5 of 8): Snake Island, N end. D'Entrecasteaux Channel (TSE), 18.xi.1984, *K. Harris s.n.* (HO 96989!); Don Heads. Between road and lagoon, N of Don (FLI), 19.x.1986, *D.I. Morris 8649* (HO!); Mersey Bluff, Devonport (FLI), 31.x.2002, *B. Nuttall s.n.* (HO 520297!); Mersey Lighthouse, Mersey Bluff (FLI), 22.ix.2005, *M.L. Baker 1617* (HO!); Railton - cleared end of Dulverton Hill Road (TNS), 22.xi.2012, *M. Wapstra 1417* (HO!).

Notes: This tufted perennial herb is cultivated in Tasmania and is known from several widely separated but localised populations. Naturalised populations are most likely garden escapes or plants persisting from abandoned gardens. It is most suited to dry coastal habitats and has been recorded forming large colonies consisting of hundreds of plants.

Extra Tasmanian distribution: SA

Status: Sparingly naturalised

POACEAE

Aira cupaniana Guss. (silvery hairgrass)

Specimens examined: Hobart, xii.1923, *A.H.S. Lucas s.n.* (NSW 551107 [*n.v.*]); Launceston (all TSE), 14.xi.1963, *E.J. McBarron 8480*, (NSW [*n.v.*]).

Notes: This annual grass is known in Tasmania from two widely separated populations collected more than 50 years ago. Notes accompanying the latest collection indicate that it grew in wasteland in the city of Launceston. The limited material and associated notes make it difficult to accurately assign a naturalised status. It is likely to have been overlooked due to its similarity to other naturalised species in the genus.

Extra Tasmanian distribution: WA, SA, Qld, NSW, ACT, Vic.

Status: Doubtfully naturalised

Avellinia michelii (Savi) Parl. (avellinia)

Specimens examined: 'Tin Dish Lagoon', Maclains Plain, Campbell Town, 10.xi.1998, *J.A. Smith s.n.* (HO 505175!); Tin Dish (all TNM), 10.xi.1998, *J.A. Smith s.n.* (HO 504252!).

Notes: This small annual grass is known in Tasmania from two specimens that appear to be duplicates of each other. The plants were collected from the outer edge of a wetland in a *Selleria radicans* herbfield surrounded by native grassland. There are no further details regarding the population. The limited material and associated collecting notes raise doubt over its naturalised status.

Extra Tasmanian distribution: WA, SA, Vic.

Status: Doubtfully naturalised

Calamagrostis epigejos (L.) Roth (wood smallreed)

Selected specimens examined (2 of 5): Tanners Creek, Arthur Highway, vi.1973, *W.R. Watson s.n.* (HO 568832!); Tanners Creek, between Forcett and Copping, Arthur Highway (all TSE), 1.iii.1977, *D.I. Morris s.n.* (HO 25222!).

Notes: This large perennial grass is known in Tasmania from several collections from a roadside ditch on the Arthur Highway in the southeast of the State. The origin of the species here is unknown. It is believed to have been deliberately eradicated and recent surveys have failed to re-find it.

Extra Tasmanian distribution: None

Status: Previously naturalised

Dichanthium sericeum (R.Br.) A.Camus subsp. *sericeum* (silky bluegrass)

Selected specimens examined (1 of 4): Tasman Highway, 2 km N of Sorell (TSE), 31.i.1982, *D.I. Morris 8246* (HO!).

Notes: This erect perennial grass is known in Tasmania from a single specimen (with several duplicates) from Sorell in the southeast of the State. Details accompanying the specimen indicate that the population consisted of approx. 20 plants. It has not been recorded since.

Extra Tasmanian distribution: WA (native), NT (native), SA (native), Qld (native), NSW (native), ACT (native), Vic. (native)

Status: Not naturalised

Digitaria ciliaris (Retz.) Koeler (crabgrass)

Specimens examined: Hobart, v.1895, *L. Rodway 6* (HO!); Hobart (all TSE), 6.vi.1895, *L. Rodway 6* (HO!).

Notes: This annual grass is known in Tasmania from two specimens from Hobart, collected more than 120 years ago. There are no notes indicating the plant's status at these sites, nor any evidence that it became naturalised in Tasmania.

Extra Tasmanian distribution: WA, NT, SA, Qld, NSW, LHI, NI, ACT

Status: Not naturalised

Digitaria ternata (Hochst. Ex A.Rich.) Stapf (fingergrass)

Specimens examined: Nubeena, 6.v.1982, [collector unknown] Ex Tasmanian Department of Agriculture Herbarium (HO 568826!); Near Nubeena (all TSE), 6.v.1982, *W.R. Watson s.n.* (HO 51390!).

Notes: This tufted annual grass is known in Tasmania from a single collection. Curtis and Morris (1994) described the distribution and habitat as "recorded from a roadside on the Tasman Peninsula", presumably based on this specimen. There is no evidence that it became naturalised in Tasmania.

Extra Tasmanian distribution: NSW

Status: Not naturalised

Echinochloa oryzoides (Ard.) Fritsch (rice barnyardgrass)

Specimen examined: Triabunna (TSE), 2.ii.1995, *D.I. Morris 86552* (HO!).

Notes: This tall annual grass is known in Tasmania from a single specimen from a population of 30–40 plants growing along a roadside ditch on the State's east coast. There is no evidence that it became naturalised in Tasmania.

Extra Tasmanian distribution: WA, Qld (doubtfully naturalised), NSW

Status: Not naturalised

Eleusine indica (L.) Gaertn. (crowsfoot grass)

Specimens examined: Bridport, top side of Westwood Street, 19.iii.1997, *M.P. Cameron s.n.* (HO 320736!); Parkers Ford Road, Port Sorell (all FLI), 8.ii.2012, *P. Collier 5428* (HO!).

Notes: This small annual grass is known in Tasmania from two specimens from roadside verges in the north of the State. The collections suggest that it is a recent arrival to the State, although the source of the introduction is unknown. The species is locally persistent at Port Sorell (P. Collier pers. comm.) whereas its persistence at Bridport is unknown.

Extra Tasmanian distribution: WA, CoI, ChI, NT, SA, Qld, NSW, LHI, NI, ACT, Vic.

Status: Sparingly naturalised

Eleusine tristachya (Lam.) Lam. (goosegrass)

Selected specimens examined (5 of 13): Outside of the Botanical Gardens [Hobart] (TSE), 17.xi.1979, *T. Shea s.n.* (HO 32149!); Hobart. University of Tasmania, football oval (TSE), 14.iii.1981, *R.J. Wilson* s.n. (HO 540714!); Midland Highway, N. of Perth (TNM), 12.iv.2013, *M. Wapstra* 1602 (HO!); Lyell Highway, N of Dawson Road (Dunrobin) turn-off (TSE), 9.vi.2013, *M. Wapstra* 1660 (HO!); Brooker Highway, showgrounds roundabout, median strip to north (TSE), 14.iv.2014, *M. Wapstra* 1853 (HO!).

Notes: This prostrate perennial grass is known in Tasmania from numerous locations in the greater Hobart area, extending through to the Coal River Valley, the lower to middle Derwent Valley, and along the Midland Highway as far north as Breadalbane, near Launceston in the State's north. Since the first collections, in 1979 from outside the Royal Tasmanian Botanical Garden, and in 1981 from Sandy Bay, it has become a widespread weed of roadsides and grasslands and is predicted to continue to increase its range throughout the State.

Extra Tasmanian distribution: SA, Qld, NSW, ACT, Vic.

Status: Naturalised

Eragrostis curvula (Schrad.) Nees (African lovegrass)

Selected specimens examined (4 of 16): Woodbury (cult.) (TNM), i.1922, *R.A. Black s.n.* (HO 121170!); Franklin, picnic area (TSR), 8.i.1967, *J.E.S. Townrow s.n.* (HO 92647!); Hobart

International Airport (TSE), 1.iv.2008, *A. Crane s.n.* (HO 547462!); Hobart, Flagstaff Gully link road, near North Warrane Sports Ground (TSE), 14.iii.2015, *M.L. Baker 3001* (HO!).

Notes: This tussock-forming perennial grass is known in Tasmania from numerous locations in the State where it is a widespread and common weed of roadsides. It was first recorded from a pasture trial conducted in 1922, although it is unknown if it was ever actively promoted as a pasture species. At the time of publication of Curtis and Morris (1994), it was only known to be naturalised at Franklin, on grassy areas adjacent to the Huon River. Recent targeted surveys have revealed large increases in its range in the State and it is now regarded as common and widespread (NBES 2016). It is predicted to continue to increase its range even though it has been, and continues to be, actively targeted for eradication. See Figure 8.

Extra Tasmanian distribution: WA, SA, Qld, NSW, ACT, Vic.

Status: Naturalised

Eragrostis tenuifolia (A.Rich.) Hochst ex Steud. (elastic grass)

Specimens examined: 30 m west of Llanherne turnoff, Cambridge, *D. Reece s.n.* (HO 128440!); Just before Seven Mile Beach turnoff on Cambridge Road, 14.iv.1972, *D. Reece s.n.* (HO 128439!); Tasman Highway, immediately west of Orford, 25.iii.2016, *J. Quarmby s.n.* (HO 585623!); Orford, between highway and Prosser River, c. 300 m W of Charles Street intersection, 7.iii.2018, *M.L. Baker 3462* (HO!) (all TSE).

Notes: This perennial grass is known in Tasmania from two disjunct roadside populations in the southeast of the State. The location of the most recent collection (Orford) was surveyed in March 2018 and several plants were found along a short section of roadside verge with other more common naturalised grasses, indicating that the taxon is locally established.

Extra Tasmanian distribution: WA, NT, Qld, NSW

Status: Sparingly naturalised

Glyceria plicata (Fri.) Fri. (plicate sweetgrass)

Specimen examined: Don Heads, Devonport (FLI), 20.xi.1986, *D.I. Morris 86123* (HO!).

Notes: This rhizomatous perennial grass is known in Tasmania from a single specimen from a farm dam overflow in the north of the State. Its similarity to the more widespread *G. declinata* Bréb. may mean that it has been overlooked. On the basis of the single collection, it is difficult to assign a naturalised status but its perennial nature suggests it could have persisted at the site.

Extra Tasmanian distribution: Vic. (as *Glyceria notata* Chevall.)

Status: Doubtfully naturalised

Holcus mollis L. (creeping fog)

Specimens examined: Tewkesbury Potato Research Farm (TNS), vi.1974, *D.I. Morris s.n.* (HO 103698!); Barcoo Road, S of Montagu (KIN), 25.ii.2009, *A.M. Buchanan 17092* (HO!).

Notes: This perennial grass is known in Tasmania from two collections from the northwest of the State. The most recent record was from a weedy roadside. There are no accompanying notes to indicate its extent at either location. The species may have been overlooked in Tasmania due to its similarity with the widespread and common *Holcus lanatus* L.

Extra Tasmanian distribution: NSW, Vic.

Status: Doubtfully naturalised

Hordeum hystrix Roth (velvet sea barleygrass)

Selected specimens examined (4 of 12): West Lagoon, Little Hampton (TNM), 2.ii.1952, *H.N. Barber s.n.* (HO 27918!); Big Green Island (FLI), 11.xii.1975, *J.S. Whinray 598* (AD [*n.v.*]); Cambridge Sports Ground (TSE), 21.xi.1973, *D.I. Morris s.n.* (HO 35213!); Nant Lane, N Bothwell (between Fordell Creek and River Clyde) (TSE), 24.i.2014, *M. Wapstra 1807* (HO!).

Notes: This erect annual grass is known in Tasmania from three widely separated populations. It appears to be well-established on the islands of the Furneaux Group and at several localities in the dry agricultural region of the Midlands. Curtis and Morris (1994) stated that it is "occasional in pastures in the Midlands". The most recent collection was from grassland in a drainage depression where it formed dense patches.

Extra Tasmanian distribution: WA, NT (doubtfully naturalised), SA, Qld, NSW, ACT (formerly naturalised), Vic.

Status: Naturalised

Molineriella minuta (L.) Rouy (small hairgrass)

Specimen examined: Hoggs Ford Road, Campbell Town (TNM), 6.x.1995, *J.A. Smith s.n.* (HO 316988!).

Notes: This small annual grass is known in Tasmania from a single collection from a freshwater wetland in the State's Midlands region. Collection notes do not give any indication of its status at the site. Based on this scant

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0 1 2 3 4 5 6 7 8 9 10
cm
Tasmanian Herbarium HO 591812
Hobart
Flora of Tasmania
East Coast Region
HO 591812
POACEAE
Eragrostis curvula (Schrad.) Nees
Arthur Highway at Boomer Bay, c. 1.9 km N of Bay Road intersection.
42° 51' 34.0" S 147° 49' 24.0" E
Grid: GDA94
Precision: 1
Altitude: 35 m.
Coll: M.L. Baker 3470 M.F. de Salas
06 Apr 2018
Roadside nature strip.
Notes: Population of c. 50 - 100 plants at this location.
Dupl. ex:
Dupl. sent to: MEL, CANB
M.L. Baker 3470

Figure 8. *Eragrostis curvula* was previously known to be sparingly naturalised in Tasmania. Recent surveys have shown the species to be a widespread and common naturalised weed of roadsides throughout the State.

information, it cannot be considered naturalised but its status should remain uncertain pending further surveys.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Doubtfully naturalised

Panicum capillare L. (= *Panicum capillare* L. var. *capillare* & *P. capillare* L. var. *occidentale* Rydb.) (witchgrass)

Specimens examined: Gunns Plains (TNS), *Colbourne* (*ex herb. Rodway*) (HO 27821!); NW Coast, North West (TNS), iii.1956, *I. Murfet s.n.* (HO 27820!); Latrobe Cemetery (FLI), 1.iv.2003, *A.M. Buchanan 160001* (HO!).

Notes: This annual grass is known in Tasmania from three collections but there is insufficient information to justify assigning a naturalised status. Investigation of the Latrobe Cemetery site could provide useful information in reviewing its status in Tasmania.

Extra Tasmanian distribution: WA, SA, NSW, Vic.

Status: Not naturalised

Panicum gilvum Launert (sweet panic)

Specimens examined: Approach to Bailey Bridge, Prince of Wales Bay (TSE), 9.vi.1976, *D.I. Morris s.n.* (HO 128471! & HO 55049!); Symmons Plains, highway just S of raceway entrance (TNM), 14.iii.2008, *M.L. Baker 1875* (HO 547458!).

Notes: This annual grass is known in Tasmania from two specimens collected from widely separated locations, both from roadside verges. The most recent collection was from a population consisting of several plants. The scarcity of collecting information associated with the specimens, and the infrequent collections, means there is some doubt regarding its status in Tasmania. See Figure 9.

Extra Tasmanian distribution: NT, Qld (doubtfully naturalised), NSW, ACT, Vic.

Status: Doubtfully naturalised

Setaria pumila (Poir.) Roem. & Schultz. subsp. *pumila* (pale pigeon-grass)

Specimen examined: Hill Street, West Hobart (TSE), 10.iii.2004, *M.L. Baker 396* (HO!).

Notes: This tufted annual grass is known in Tasmania from a single specimen from an amenity street-tree planting in the south of the State. All plants were removed and destroyed and a survey of surrounding area did not reveal any additional individuals. For a discussion of this occurrence see Baker (2005).

Extra Tasmanian distribution: WA, SA, Qld, ACT, Vic.

Status: Not naturalised

Sorghum bicolor (L.) Moench (sorghum)

Specimens examined: Margate tip, 10.vi.2004, *M.L. Baker 450* (HO!); Risdon Vale, Risdon Vale Creek (all TSE), 5.iv.2007, *M.L. Baker 1798* (HO!).

Notes: This robust annual grass, cultivated in tropical and subtropical regions of the world for its edible grain, is known in Tasmania from only three plants recorded in the south of the State. Two were growing in a weed-infested urban creek bank and were thought to have arisen from discarded bird cage refuse. The other was a single plant growing at a municipal tip. The small number of plants and its tropical growing requirements suggest that it only exists as a transient weed in Tasmania.

Extra Tasmanian distribution: WA, Col, Chl, NT, SA, Qld, NSW, ACT (doubtfully naturalised)

Status: Not naturalised

Sorghum halepense (L.) Pers. (Johnson grass)

Selected specimens examined (5 of 7): Lindisfarne (TSE), 29.i.1920, *J.E. Phillip s.n.* (MEL2139750 [*n.v.*]); Tasmania (cult.) (TNM), ii.1921, *R.A. Black s.n.* (HO 105340!); Campbell Town (TNM), 7.iii.1921, *R.A. Black s.n.* (MEL2139751 [*n.v.*]); Queens Domain, Hobart, Edge of top carpark (TSE), 20.ii.2001, *P. Bramich s.n.* (HO 512572!); Margate Tip (TSE), 10.vi.2004, *M. Baker 449* (HO!).

Notes: This robust perennial grass is known in Tasmania from a small number of specimens. The earlier records are thought to be from plants cultivated in pasture trials. The Queens Domain collections are thought to have arisen from bird seed that was scattered in the area.

Extra Tasmanian distribution: WA, SA, Qld, NSW, ACT, Vic.

Status: Doubtfully naturalised

Discussion

Based on this study, the number of naturalised taxa in Tasmania recognised in the 2016 edition of the Tasmanian Vascular Plant Census (de Salas & Baker 2016) should be reduced by 75 because 37 taxa previously considered to be naturalised are better regarded as never having been naturalised in Tasmania. Based on the available evidence, a further 38 taxa are best regarded as doubtfully naturalised.

Of the 150 taxa listed in de Salas and Baker (2016) as *sparingly naturalised*, eight were deemed to be *status uncertain* (Table 1). These species will be the topic

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0 1 2 3 4 5 6 7 8 9 10
cm
Tasmanian Herbarium HO 547458
Hobart
Flora of Tasmania
Midlands Region
HO 547458
POACEAE
Panicum gilvum Launert
Symmons Plains, highway just S of raceway entrance
41° 39' " S 147° 14' " E
Grid: MGA94 ESK 520828 5387730
Precision: 1 Altitude: 170 m.
M.L. Baker 1875 14 Mar 2008
Roadside verge
Decumbent to prostrate grass
Notes: Plants confined to first 1-2m of verge (area treated with herbicide). Several plants in near vicinity

Figure 9. *Panicum gilvum* is known in Tasmania from two specimens collected from widely separated locations, both from roadside verges. The most recent collection was from a population consisting of several plants. The scarcity of collecting information associated with the specimens and the infrequent collections means there is some doubt regarding its status in Tasmania.

of a future paper (de Salas *et al.* in prep.) and are not discussed further here.

Thirty-seven taxa were determined to be *not naturalised*. These are characterised by having been introduced to Tasmania but having no evidence to suggest that they were ever truly naturalised. The clear majority are annual or short-lived perennials that have been recorded on single occasions (e.g. *Hyoscyamus albus* (Figure 5) and *Ranunculus arvensis*). Several taxa have only been recorded as collections made from cultivated plants (e.g. *Hedysarum coronarium* (Figure 5) and *Taraxacum kok-saghyz* (Figure 2)). Eleven of the taxa were last collected more than 50 years ago and, four had not been collected for more than 100 years. One of these, *Veronica peregrina*, was collected 169 years ago. *Hibiscus trionum* is the most often collected and widespread of this group. It is associated with cultivated ground, such as urban vegetable gardens. However, it does not appear to persist at these sites and cannot be considered even sparingly naturalised in Tasmania. Nine of the taxa are not recorded as naturalised anywhere in Australia. However, several are known to be widely naturalised throughout the Australian mainland (e.g. *Digitaria ciliaris*, *Carrichtera annua* and *Sorghum bicolor*) and could conceivably become so in Tasmania.

Six taxa were determined to be *previously naturalised*. These are characterised as taxa that were introduced and naturalised to some degree in the past, or highly likely to have become naturalised, but which have been subsequently eradicated. Each was recorded either as small, single populations, or from a small number of very localised populations. Several of the populations originated from ornamental garden plantings (e.g. *Hakea laurina* and *Cynara cardunculus* subsp. *flavescens*). The remainder are considered to be agricultural weeds and were most likely introduced to Tasmania as contaminants of crop seed, livestock feed or some other agricultural vector. *Onopordum acaulon* and *Cuscuta suaveolens* (Figure 4) are recognised as serious weeds elsewhere in the world (Parsons & Cuthbertson 2001) and are examples of species that were found growing in single localised populations. These species were deemed to be potentially serious weed threats and therefore targeted for eradication. Whilst there is no evidence that these taxa would have become naturalised, experience from elsewhere in Australia and overseas (Parsons & Cuthbertson 2001) suggests that they would readily naturalise in Tasmania if no steps were taken to control them.

Thirty-eight taxa were determined to be *doubtfully naturalised*. These are characterised as being introduced species known from a small number of collections with scant notes detailing their habitat and population extent. Some are taxa that could be easily mistaken for more common related species (e.g. *Raphanus maritimus*, *Panicum gilvum* (Figure 9) and *Holcus mollis*) and could therefore be more common and widespread than evidence suggests. Others may have been overlooked due to their small size (e.g. *Lysimachia minima*) or because they occupy under-surveyed habitats such as wetlands (e.g. *Utricularia gibba*). The taxa in this group are commonly associated with a lack of contextual collecting information accompanying the records, and as a result there is uncertainty surrounding their naturalised status. *Brassica oleracea* (Figure 3) is a case in point. Twelve collections of this species are known, with all collected over a period spanning nearly 100 years from widely disjunct locations. However, only a single specimen is annotated in terms of its status (cultivated). All other specimens lack notes regarding population, habitat and status details. Thus, the source of the plants, and whether they appeared to be in self-sustaining populations, is unknown.

Thirty-nine taxa were retained as *sparingly naturalised*. These are known from only a small number of collections from non-cultivated plants. They are often from widely separated but localised populations, and represented by specimens collected many years apart. They show

Table 1. Taxa previously recorded as sparingly naturalised but now regarded as status uncertain.

Species	Common name
Sigesbeckia orientalis L.	Indian weed
Atriplex semibaccata R.Br.	berry saltbush
Lawrencia squamata Nees	thorny saltmallow
Passiflora cinnabarina Lindl.	red passionflower
Veronica notabilis F.Muell. ex Benth.	forest speedwell
Cladium procerum S.T.Blake	leafy twigsedge
Cyperus sanguinolentus Vahl.	dark twigsedge
Amphibromus fluitans Kirk	floating swampgrass

evidence of persistence but no evidence of spread or noteworthy impacts on ecosytems or agriculture.

Twenty-two taxa were determined to be *naturalised*. Many of these are characterised as being widely cultivated ornamental plants that have actively spread from plantings into adjacent amenity and recreational areas, or into remnant bushland adjacent to suburban and peri-urban locations (e.g. *Acacia baileyana*, *Kniphofia uvaria* (Figure 7) and *Senecio angulatus*). Others are accidental introductions that have undergone recent and significant increases in their distribution across the state (e.g. *Eragrostis curvula* (Figure 8) and *Eleusine tristachya*) and will most likely remain a permanent part of the flora of Tasmania.

The species that are recorded infrequently and regarded as doubtfully or sparingly naturalised may, with active searching, prove to be more widespread and possibly meet the definitions of being fully naturalised. Other taxa that resemble more common and widespread species may have been overlooked or misidentified, and therefore the records may misrepresent their status. It is also possible that many of the species are very restricted in their distributions and are uncommon, and for that reason they go undetected for long periods of time. Schmidt-Lebuhn *et al.* (2013) examined non-geographic collecting bias in the daisy family in Australia and showed that there exist biases against collecting introduced plants, species with spines and unattractive flower colours, as well as very small plants. Botanists in general are more interested in recording and collecting natives, whilst species such as succulents, spiny plants and those that are too large to fit on a single herbarium sheet are more likely to be ignored due to their inherent collecting and processing difficulties.

Doubtfully naturalised and sparingly naturalised taxa are good candidates for follow-up surveys, especially where accurate and descriptive locality notes are to be included with the specimen, allowing for a more accurate assessments of their status. If follow-up surveys find taxa to be present, they may serve as good candidates for localised eradication; history has shown that, if left, there is a high chance that they will become naturalised. An appraisal by Rozefelds and MacKenzie (2005) of the earliest catalogues of Tasmanian naturalised plant species (Spicer 1878a; 1878b) showed that, of the 50 species identified as being present but not yet naturalised by the 1870s, more than 95% of them were naturalised by 2005.

The authors would be pleased to receive specimens or information relevant to the listed species as new information may lead to a better understanding of their status in Tasmania.

Acknowledgements

The authors would like to thank Neville Walsh for his helpful comments and observations regarding *Nasturtium microphyllum*. Gintaras Kantvilas is thanked for reviewing and fine-tuning multiple drafts of the manuscript, and Miguel de Salas is thanked for his helpful comments. Two anonymous reviewers are thanked for their valuable suggestions, which improved the manuscript.

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Muelleria

38: 71–75

Published online in advance of the print edition, 17 February 2020

ROYAL BOTANIC GARDENS VICTORIA

A new combination in *Angiactis* (lichenised Ascomycetes: Roccellaceae)

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Introduction

The genus *Angiactis* was introduced by Aptroot *et al.* (2008) to accommodate three crustose species of the lichen family Roccellaceae, recorded from southern Australia, Bermuda and the Galápagos Islands respectively. The type species, *A. littoralis*, was initially described by Kantvilas (2004) in the genus *Lecanographa*, but with considerable hesitation as that genus was perceived simply as the best fit at the time for what was clearly a novel and remarkable species.

Angiactis is characterised by an ecorticate, crustose thallus containing gyrophoric acid, a thick, cretaceous medulla, a *Trentepohlia* photobiont, ascomata with a thick, prominent, thalline margin, a dark-pigmented or carbonised, cupular proper excipulum in which the dark pigments are KOH–, hemiamyloid, eight-spored asci approximating the *grumulosa*-type (terminology after Egea & Torrente 1994), slender, branched and anastomosing paraphysoids, hyaline, transversely 3–7-septate ascospores with cylindrical locules and usually with a thin gelatinous sheath, and rod-shaped conidia. *Lecanographa* differs from *Angiactis* chiefly in that its ascomata lack a thalline margin (Kantvilas 2004; Aptroot *et al.* 2008) and that the dark ascomatal pigments react strongly olive in KOH.

Abstract

The new combination *Angiactis banksiae* (Müll.Arg.) Kantvilas & Stajsic is proposed. The ecology of this remarkable species, known from coastal south-western Western Australia, Victoria, Flinders Island (Tasmania) and southern New South Wales, is discussed.

Keywords: *Lecanographa*, rare species, taxonomy

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

In the course of reviewing lichen type material held at the National Herbarium of Victoria (MEL), one of us (VS) located material of *Platygrapha banksiae* Müll.Arg., a name that has not been in use since its description (Müller 1893). Field work at the type locality failed to locate this species but searches of similar habitats at nearby Westernport Bay yielded collections which matched the protologue and type of *P. banksiae*. Detailed study proved that the material was also identical to *Angiactis littoralis*. The necessary new combination is introduced here, and *A. littoralis* is placed in synonymy.

Material and methods

This study is based on specimens housed in the Australian National Herbarium (CANB), the National Herbarium of Victoria (MEL) and the Tasmanian Herbarium (HO), as well as on field observations by the authors. Morphological and anatomical investigations were undertaken on hand-cut sections of the thallus and apothecia, using standard methods, reagents and stains (water, 10% KOH, Lactophenol Cotton Blue, ammoniacal erythrosin and Lugols Iodine). Measurements of ascospores are presented in the format 5th percentile–*average*–95th percentile, with outlying values in brackets and *n* being the number of observations. Routine chemical analysis was undertaken using standard methods (Orange *et al.* 2010; Elix 2014).

Taxonomy

Angiactis banksiae (Müll.Arg.) Kantvilas & Stajsic comb. nov.

Mycobank No.: MB 833564

Platygrapha banksiae Müll.Arg., *Bull. Herb. Boissier* 1: 55 (1893); *Schismatomma banksiae* (Müll.Arg.) Zahlbr., *Cat. Lich. Univ.* 2: 554 (1923) [1924]. Type: [Australia] Victoria: Cheltenham, [37°58'S 145°03'E], on bark of *Banksia serrata* by [the] sea, 1892, *Rev. F.R.M. Wilson 364* (lectotype-G, here designated; isolectotypes–MEL 26181!, NSW).

Angiactis littoralis (Kantvilas) Aptroot & Sparrius, *Bryologist* 111: 513 (2008); *Lecanographa littoralis* Kantvilas, *Symb. Bot. Upsal.* 34(1): 197 (2004).

Type: Australia. Western Australia, Cape Leeuwin, on dead *Melaleuca* twigs in coastal heathland, 34°22'S 115°07'E, 9 October 1992, *G. Kantvilas 320/92 & J. Jarman* (holotype– HO!; isotypes: BM!, GZU!, PERTH!, UPS!).

Thallus scurfy-crustose to ± byssoid, whitish to pale yellowish cream or greyish green, 0.1–1 mm thick, forming irregular, rather discontinuous, bullate-areolate patches to c. 10 cm wide; photobiont cells irregularly roundish, 12–20 x 12–14 µm. Ascomata apothecia, roundish, 0.3–1.2 mm wide, adnate to basally constricted, scattered and solitary, or in clusters of 2–4;

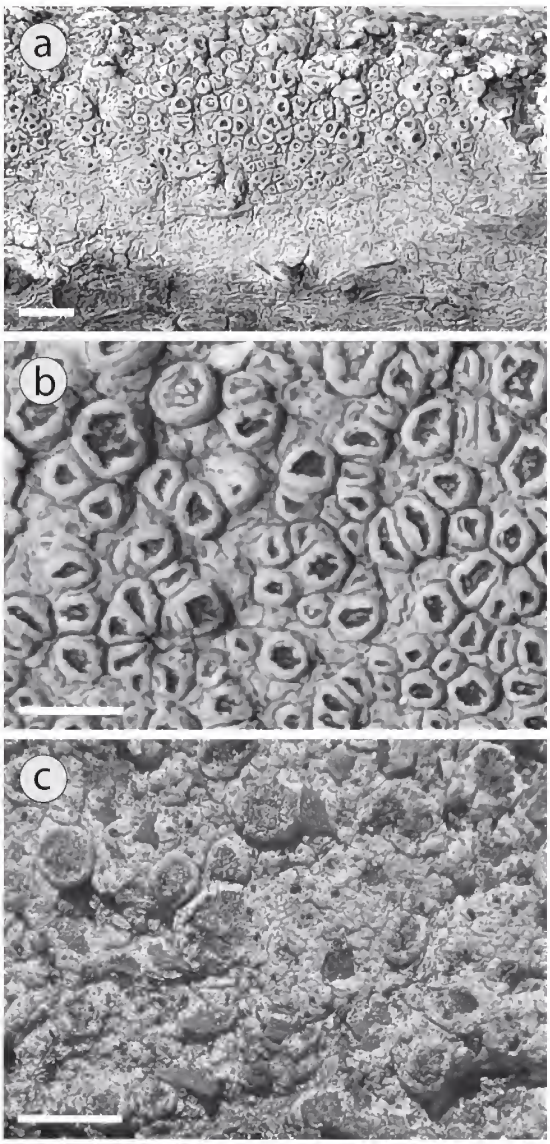

Figure 1. Morphology of *Angiactis banksiae*. a, b. Corticolous specimen, Victoria (*V. Stajsic* 7002 & *J.G. Eichler*). c. Saxicolous specimen, New South Wales (*P.M. McCarthy* 4476). Scales: a = 2 mm; b, c = 1 mm.

thalline margin entire, 60–100(–150) µm thick; disc plane, undulate to convex, black, usually coarsely and thickly white pruinose. Proper excipulum in section 6–20 µm thick laterally, 25–40 µm thick basally, but extending a 'foot' into the medulla. Hypothecium hyaline to pale brownish, 30–60 µm thick. Hymenium 70–100 µm thick; asci 60–90 x 10–18 µm, approximating the *grumulosa* type, non-amyloid apart from a small, amyloid ring in the tholus when young; paraphysoids 1–1.5 µm thick, strongly conglutinated. Ascospores ellipsoid-fusiform, 3–6(–7)-septate, (11–)18–*20.3*–23(–24) x (4–)5–*5.5*–6.5 µm (*n*=110); wall 0.5–1 µm thick; gelatinous perispore seen mainly in immature spores. Pycnidia immersed; conidia rod-shaped, 5–8 x 1–1.5 µm. Chemical composition: gyrophoric acid and lecanoric acid (trace); thallus K–, KC+ reddish, C+ reddish, P– (Figures 1 and 2).

***Remarks*:** This species is easily recognised in the Australian biota by its cretaceous, pale thallus, pruinose apothecia with a thalline margin (Figure 1) and, anatomically, by the *grumulosa*-type asci and ellipsoid-fusiform, transversely septate ascospores. There are no known confusing species. Minor variations in thallus chemistry and morphological characters, pertaining mainly to apothecial shape and position, separate it from the other species of the genus (see Aptroot *et al.* 2008).

The *grumulosa*-type ascus was defined and illustrated by Egea and Torrente (1994). It features an essentially non-amyloid ascus wall but with a minute amyloid ring in the tholus, visible at certain stages of development. When first describing *A. littoralis* (as a *Lecanographa*), Kantvilas (2004) observed that the asci of this species deviated slightly from the *grumulosa*-type in the strict sense in that rather than having a ring, the tholus featured a thin amyloid sheath adjacent to the ascoplasm. Further study suggests that *Angiactis* asci can vary somewhat through their development (Figure 2). The ring is best observed in young asci. As the ascospores develop and the tholus becomes compressed, the ring also becomes compressed into the thin amyloid sheath as described and illustrated by Kantvilas (2004) or is obliterated altogether.

***Distribution and ecology*:** *Angiactis banksiae* is now known from south-western Western Australia, Victoria, southern New South Wales and Flinders Island (Bass Strait). In each area, it has been recorded from quite different habitats, although nowhere is it common, and it remains to be established as to what its core habitat

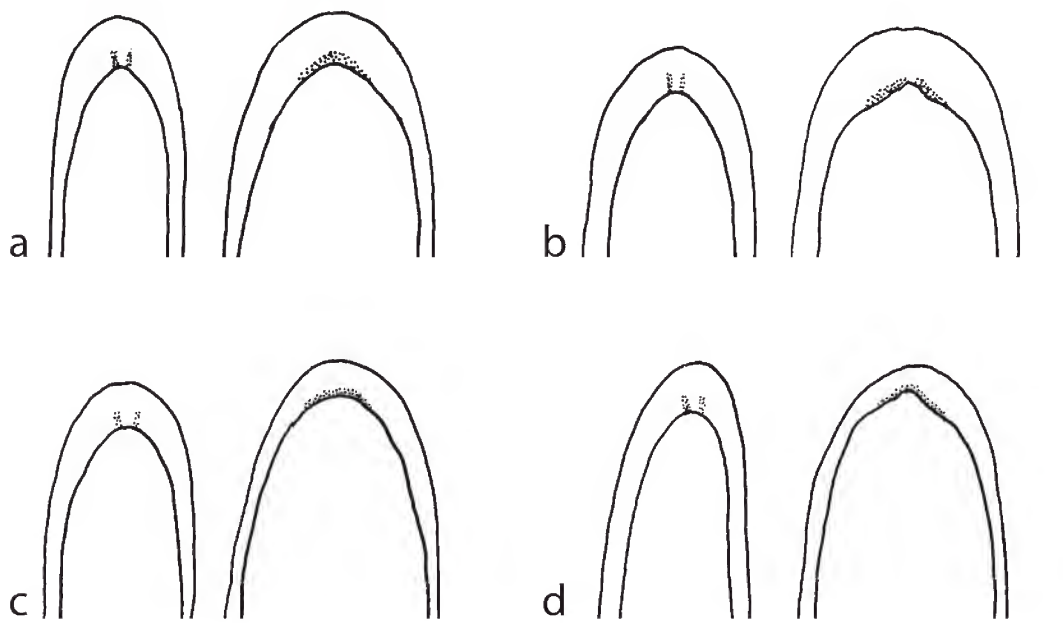

Figure 2. Semi-schematic depiction of the asci of *Angiactis*, with amyloid parts (after pretreatment with KOH) stippled; young asci on the left, mature asci on the right. a. *Angiactis banksiae* (isotype, MEL). b. *A. banksiae* (*McCarthy* 4476); c. *A. banksiae* (*Stajsic* 7002 *& Eichler*). d. *A. spinicola* (Galápagos, *Bungartz* 7948; HO).

and ecological requirements might be. The common feature of all the localities is that they are coastal, which is consistent with the distribution of the two other species of the genus, found on Galápagos and Bermuda. In Western Australia, *A. banksiae* grows on the twigs of shrubs in dense, low coastal heathland. On Flinders Island, it is confined exclusively to large outcrops of calcarenite, where it is restricted to shady underhangs, associated with *Enterographa cretacea* P.M.Mcarthy & Elix. On the south coast of New South Wales, this species occurs on moderately to strongly sheltered siliceous rocks, principally quartzitic and other hard sandstones, as well as shale, in and above the supralittoral zone of rocky seashores. It forms part of a rich community dominated by crustose lichens, including *Amandinea* spp., *Buellia* spp., *Catillaria austrolittoralis* Kantvilas & van den Boom, *Diploicia canescens* subsp. *australasica* Elix & Lumbsch, *Enterographa cretacea*, *Halecania subsquamosa* (Müll.Arg.) van den Boom & H.Mayrhofer, *Opegrapha* spp., *Porina corrugata* Müll.Arg., *P. guentheri* (Flot.) Zahlbr. and *Solenopsora vulturiensis* A.Massal. In Victoria, *Angiactis banksiae* is known from a single site at Jam Jerrup, Westernport Bay, where it grows on the branches of *Avicennia marina* subsp. *australasica* (Grey Mangrove), and is associated with *Caloplaca subluteoalba* S.Y.Kondr. & Kärnefelt, *Enterographa divergens* (Müll.Arg.) Redinger, *Opegrapha varia* Pers. and several additional, as yet unidentified crustose lichens. Most of the historic collections were gathered from *Banksia integrifolia* subsp. *integrifolia*, but a search for the lichen on this tree species in Victoria was not successful. *Angiactis banksiae* has been searched for in coastal habitats across its range elsewhere, notably along the South Australian coast, on Kangaroo Island and the Tasmanian mainland, but again without success.

Lichens have a remarkable propensity for "finding" their niche. Thus it is not unusual to find typically alpine species in lowland, fire-protected refugia; examples include *Thamnolia vermicularis* (Sw.) Schaer. and *Parasiphula fragilis* (Hook.f. & Taylor) Kantvilas & Grube, two high elevation taxa that have been found in lowland dry sclerophyll woodland on fire-protected rock plates. Similarly, typical wet forest lichens, such as species of the Lobariaceae and Sphaerophoraceae, are sometimes found in marginally moister, highly protected microhabitats in a dry environment. Terricolous species that might normally be found in a dry exposed site, e.g. *Trapelia* spp., can become established on the elevated soil mound of a toppled wet forest tree. Narrow ecological niches and highly disjunct distributions are also not uncommon in lichens. For example, a very similar ecological range is displayed by *Porina corrugata*, which occupies an almost identically broad suite of substrata (siliceous rock, limestone, and *Banksia* and *Melaleuca* stems) in coastal & seashore habitats across southern mainland Australia and Tasmania, as well as in South Africa and New Zealand. Further examples are shown by the Roccellaceae, notably *Ocellomma rediuntum* (Stizenb. ex Hasse) Kantvilas, Gueidan & Tehler, which occurs in starkly different habitats at several, widely separated localities in south-eastern Australia and western North America (Kantvilas *et al.*, in press). At the same time, the Roccellaceae is also noteworthy for containing a relatively high number of small genera, rare and highly localised species, and species of high conservation value (e.g. Ertz *et al.* 2015; Follman & Werner 2000; Grube 1998; Tehler & Irestedt 2008; Tehler *et al.* 2009). *Angiactis banksiae* fits this profile extremely well and the next discovery of this remarkable species is greatly anticipated.

Other specimens examined: **NEW SOUTH WALES:** South Coast, 5 km N of Bermagui, Camel Rock, 36°22'41" 150°04'37"E, 3 m alt., on sheltered quartzitic sandstone on the seashore, above the splash zone, 10 Feb. 2016, *P.M. McCarthy* 4476 (CANB, HO); South Coast, Pooles Beach, 3 km S of Mystery Bay, 36°18'46"S, 150°07'57"E, *c.* 1 m alt., on exposed shale outcrops along foreshore, 18 Nov. 2016, *P.M. McCarthy* 4532, 4557 (CANB); South Coast, Ben Boyd National Park, Green Cape Peninsula, Haycock Point, 36°57'03"S, 149°56'10"E, *c.* 1.5 m alt., on hard, sheltered sandstone on the seashore, 21 Mar. 2018, *P.M. McCarthy* 4754 (CANB). **VICTORIA:** Black Rock, 37°58'S 145°01'E, 26 Dec. 1899, *R.A. Bastow s.n.* (MEL 1071547); *ibid.* (MEL 515681); Sandringham, 37°57'S 145°00'E, 26 May 1900, *R.A. Bastow* 88 (MEL 515680); *ibid.* (MEL 26182); Jam Jerrup, Stockyard Point, *c.* 500 m S from the carpark, 38°19'52.35"S 145°30'57.04"E, corticolous on living stems and branches of *Avicennia marina*, 29 Mar. 2014, *V. Stajsic* 7002 & *J.G. Eichler* (BR, HO, MEL). **TASMANIA:** Flinders Island, Cave Beach, 40°01'S 147°53'E, 2 m alt., on soft, Tertiary limestone [calcarenite], 28 Dec.1997, *G. Kantvilas* 311/97 (HO); *ibid.*, 23 Jan. 2006, *G. Kantvilas* 81/06 (HO); *ibid.*, 23 Mar. 2014, *G. Kantvilas* 226/14 (BR, HO).

Notes on *Platygrapha* in Australia

The genus *Platygrapha* was introduced by Nylander (1855) and is now regarded as a synonym of *Schismatomma* (Tehler 1993), although the many species it formerly included are now combined in several genera, chiefly in the Roccellaceae and Graphidaceae. McCarthy (2018) lists two species of *Platygrapha* for Australia: *P. banksiae*, which is dealt with above, and *P. congerens* Nyl. The latter species is represented solely by the type specimen (in H), attributed to the 19th Century collector Augustus Oldfield, originating from the herbarium of William Mitten. Although labelled as being from Tasmania, this is by no means certain as intensive lichenological activity in Tasmania over the last four decades has not revealed any further collections.

Oldfield collected in Tasmania as well as on the Australian mainland (Henderson & Henderson 2018), whereas Mitten's herbarium (now held in the New York Botanic Gardens Herbarium) comprises specimens from all over the world. Therefore a confusion of provenance is possible. The type of *Platygrapha congerens* was studied by Tehler (1993) who ascribed it to the Lecanorales. The same specimen was also examined by the first author who observed the following salient characters: apothecia 0.2–0.5 mm wide, occurring singly or grouped in stroma to 1 mm wide; disc red-brown to black-brown, hypothecium reddish brown, ± wedge-shaped in section; asci approximating the *Bacidia*-type, eight-spored; paraphyses sparsely branched; ascospores hyaline, narrowly cylindrical, 3-5-septate, 14–17 × 3–3.5 µm. Until further collections are made, this taxon remains unclassified, but its position in any genus of the Roccellaceae is untenable.

Acknowledgements

We thank Jean Jarman for preparing the figures for publication. GK thanks Saara Velmala and Pina Milne for their hospitality during his visits to the Finnish Museum of Natural History (H) and the National Herbarium of Victoria (MEL) respectively.

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Muelleria

38: 77–85

Published online in advance of the print edition, 17 February 2020

ROYAL BOTANIC GARDENS VICTORIA

Two new species of *Asproinocybe* (Tricholomataceae) from Australasia

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Abstract

Asproinocybe lyophylloides sp. nov. from south-west Western Australia, and *A. daleyae* sp. nov. from New Zealand, are described based on morphological and molecular data. These are the first published records of the genus in Australasia. Both species have lilac tones to the fruitbody, as well as tuberculate inamyloid basidiospores, typical of the genus.

Keywords: Biannulariceae, citizen science, Entolomataceae, Lyophyllaceae, taxonomy, *Tricholosporum*

Introduction

The two closely related genera *Asproinocybe* R.Heim and *Tricholosporum* Guzman can be differentiated on the basis of irregularly turberculate spores in *Asproinocybe* and cruciform spores in *Tricholosporum*. Both genera have a tricholomatoid habit but were recognised as distinct from *Tricholoma* by several authors (Baroni 1982, Reid *et al.* 1998, Bohus *et al.* 1999, Guzman *et al.* 2004, Angelini *et al.* 2014). *Tricholosporum* appears to be a widespread genus with 15 species known from North and South America, Africa, Asia, the Canary Islands and Europe (Contu & Mua 2000, Guzman *et al.* 2004, Xu *et al.* 2018). *Asproinocybe* also has a broad distribution, but the species appear to be quite localised in their regions of origin. Five species of *Asproinocybe* are currently known: *A. lactifera* from Africa (Heim 1969a; Petersen 2001), *A. ianthinocystis* (Singer) Singer ex Guzman from Argentina, *A. nodulospora* (Babos & Bohus) Guzman & Contu from Hungary, *A. russuloides* from Africa (Heineman 1977) and *A. superba* (Watling) Guzman from Malaysia (Watling 1997, Guzman *et al.* 2004).

In the course of conducting a citizen science fungal taxonomy pilot study and a fungal barcoding project at the National Herbarium of

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

Victoria, Australia, several collections thought to be novel taxa were examined and sequenced. At the same time, a similar species was found in New Zealand by a member of the iNaturalist citizen science community and sequenced as part of an extensive barcoding project. We provide descriptions of the two new species and discuss the phylogenetic position of *Asproinocybe* and *Tricholosporum*.

Methods

Macroscopic characters were described and measured from fresh material, field notes, or dried herbarium collections. Microscopic characters were described from examination of dried herbarium material. Hand-cut sections were rehydrated in 5% KOH solution and mounted with Congo red stain to observe the hymenium, trama and pellis tissues. Spore size, shape, ornamentation and amyloidity were observed in lamellae tissue mounted in Melzer's reagent. Measurements of microscopic characters were taken on an Olympus BX-52 microscope at ×400 or ×1000. Measurements are given as a raw range with mean ± standard deviation (SD) of *n* measurements in parentheses. Names of herbaria are abbreviated according to Thiers (2019+).

Protocols for DNA extraction (E.Z.N.A. forensic kit), PCR and sequencing followed those in Lebel & Syme (2012) and Lebel *et al.* (2015) and references therein. Assembly, manual editing and preliminary alignment of sequences were performed within Geneious v.9.1.7 (Biomatters Ltd). Individual alignments for ITS sequences were then manually edited in Bioedit v7.1.3 (Hall 2011). Alignments are available in supplementary material (S1).

Sequences of the ITS representing a range of species within Biannulariaceae, Entolomataceae, Tricholomataceae and Lyophyllaceae were retrieved from GenBank to aid the broad placement of sequences generated for this study. *Resinomycena rhododendri*, *Panellus stipticus* and *Mycena pura* were included as outgroups. Novel sequences representing collections from Australasia generated for this study are listed in Table 1.

Phylogenetic analyses were performed with Bayesian inference (BI) in MrBayes 3.2.6 (Ronquist & Huelsenbeck 2003) using the CIPRES Science Gateway v3.1 (Miller *et al.* 2010). The dataset comprised 79 ITS sequences of 838 bp. Gaps in alignments were treated as missing data. Bayesian posterior probabilities (PP) were approximated by the Metropolis-coupled Markov chain Monte Carlo method (Geyer 1991). Two parallel runs were conducted with one cold and four heated chains each for 8,000,000 generations, starting with a random tree. Trees were saved every 1000th generation. Convergence was considered to be reached when the average SD of split frequencies continuously dropped below 0.008. Trees obtained before reaching convergence were discarded as burn-in; the resulting consensus trees were visualised using FigTree v1.3.1 (Rambaut 2014).

Results and Discussion

Taxonomy

Asproinocybe daleyae J.A.Cooper, sp. nov.

Mycobank No.: MB 832306

Differs from other species of *Asproinocybe* in Australasia in the presence of cystidia.

***Type*: New Zealand.** Auckland, Howick, Mangemangeroa Valley Walkway, *W. M. Daley*, 6 March 2016 (holotype PDD 106796!).

Etymology. Named after the collector, Wanda Daley.

Basidiomata tricholomatoid habit, solitary to gregarious. *Pileus* to 40 mm diam., broadly convex becoming plane, margin smooth, entire, incurved at first then straight, sometimes slightly wavy and partly unevenly crenate; dry to the touch, finely fibrous; overall colour greyish violet at the perimeter (17B3) darkening to brown at the centre (8F6), unchanging on bruising. *Context* to 5 mm thick, firm, whitish becoming greyish, somewhat brittle. *Lamellae* adnexed to sinuate with small decurrent tooth, thin to moderately broad, close, with 2–3 tiers of lamellulae; margins smooth; pale violet (17A3, 18A3), bruising reddish when damaged. *Stipe* to 40 mm long x 5–8 mm diam., stout, central, equal, dry, pruinose at apex, otherwise appressed longitudinally fibrillose; pale violet grey (17D2, 17D3) bruising dull, rusty brown; context solid, firm, pale cream. *Basal rhizomorphs* white, extensive. *Taste* and *odour* not distinct. *Spore print* white.

Spores 6.0–8.0 × 4.1–5.5 µm (7.0 ± 0.5 × 4.8 ± 0.34, Q= 1.1–1.8, Q_m = 1.47, n=16), hyaline, inamyloid, densely tuberculate, ornamentation up to 1.0 µm high. *Basidia*

Figure 1. a. Typical habitat of *Asprocinocybe daleyae* sp. nov.; b. fruitbodies (PDD 106540, PDD 106796), scale bars 10 mm; c. pleurocystidia; d. cheilocystidia; e. basidia; f–g. spores. Scale bars 10 µm.

20–30 × 5–7 µm, cylindric to narrowly clavate, 4-spored. *Pleurocystidia* oblong to ellipsoid or utriform, thin walled 25–30 × 10–13 µm; *cheilocystidia* ellipsoid and frequently rostrate, occasionally thick-walled and with brown intra-cellular pigment 25–30 × 8–12 µm. Lamellar edge with patches of brown amorphous encrusting pigment. *Pileipellis* an undifferentiated cutis of hyaline hyphae 3–5 µm diam., forming a layer 15–30 µm broad overlying a broad context 400–500 µm wide, of tightly interwoven, thin-walled hyaline hyphae, 3–5 µm broad. Clamp connections not observed.

***Additional material examined*: NEW ZEALAND**. Auckland, Howick, Mangemangeroa Valley Walkway, *W.M. Daley*, 17 April 2017 (PDD 106540!).

***Habit, habitat and distribution*:** on soil and known from a single locality in remnant coastal forest dominated by *Metrosideros excelsa* and *Beilschmedia tarairi*.

Notes: Due to the violet colouration and general fruitbody habit, this species can be mistaken for species of *Lepista*. However, the densely tuberculate spore ornamentation enable correct placement of the species.

Asproinocybe lyophylloides K.Syme & T.Lebel, sp. nov.

Mycobank No.: MB 831967

Differs from other species in the paler lilac tones of the basidiomata and its association with Myrtaceae.

***Type*: AUSTRALIA.** Denmark, William Bay National Park, Bilbbulmun track west of William Bay Road, *K.Syme 1349/04*, 30 June 2004 (holotype MEL2292252!, isotype PERTH 7367457!).

***Etymology*:** Named for its resemblance to species of the genus *Lyophyllum*.

Basidiomata tricholomatoid habit, gregarious, sometimes caespitose in small groups, or occasionally solitary. *Pileus* 31–88 mm diam., broadly convex becoming plane, margin smooth, entire, incurved at first then straight, sometimes slightly wavy and partly unevenly crenate; dry to very slightly tacky to touch, smooth with a minute, felt-like, easily removed or bruised overlying whitish to grey bloom, and with conspicuous, slightly raised darker (8F4) translucent blotches where the bloom has rubbed off on some basidiomata; overall colour variably dull, brownish (5E3–5E) or greyish (5E6–6E6) with flush of pale violet in parts (17B3), becoming darker in age or when bruised (nearer 6F4, 8F3). *Context* 5–8 mm thick, firm, whitish becoming greyish, somewhat brittle. *Lamellae* adnexed to sinuate, thin to moderately broad, close, up to 30 mm long × 5–9 mm deep, with 2–3 tiers of lamellulae; margins smooth or unevenly serrate, face often ridged, sometimes anastomosing and with some cross veining; pale violet (18A3–18A4) to greyish violet (13D2–17C3), bruising reddish brown (16D2) when damaged, somewhat waxy texture. *Stipe* 22–84 mm long x 8–21 mm diam., stout, central, terete, almost equal, dry, pruinose at apex, otherwise appressed longitudinally fibrillose; pale greyish mauve (16D3–17C3) with pale violet tinge (18A3–18A4), rapidly bruising dull, rusty brown (5C6); context solid, firm, pale cream. *Basal rhizomorphs* white, extensive. *Taste* and *odour* not distinctive or sometimes 'mushroomy'. *Spore print* white.

Spores 5.5–6.9 × 3.5–5.2 µm (6.31 ± 0.21 × 4.87 ± 0.43, Q= 1.4 –1.83, Q_m = 1.67, n=40), hyaline, inamyloid but golden in Melzer's, irregularly tuberculate-angular ornamentation up to 0.8 µm high. *Basidia* 28–35(–38) × 5–7 µm, cylindric to narrowly clavate, 4-spored. *Pleuromacrocystidia*, *pleuropseudocystidia* and *cheilomacrocystidia* absent. *Hymenophoral trama* composed of filamentous hyphae 3–5 µm diam. and slightly inflated, septate, shorter hyphae forming jigsaw-like pattern 5–8 µm broad. *Pileipellis* an undifferentiated cutis of hyaline hyphae 3–5 µm diam., which in young specimens appears to be slightly gelatinised, forming a layer 20–38 µm broad, becoming compacted in older sporocarps to form a thin 5–10 µm broad layer; overlying a broad context 450–800 µm wide, of tightly interwoven, thin-walled hyaline hyphae, 3–6(9) µm broad. Clamp connections rarely observed.

***Additional material examined*: AUSTRALIA**. WESTERN AUSTRALIA, Walpole, Mandalay Beach *K.Syme 3023*, 26 July 2018, MEL2432747!; Albany area, Two Peoples Bay Nature Reserve, Fitzpatrick's Track, 28 June 2007, *K.Syme 1953/07* & *R.M.Robinson*, MEL2432720!; Denmark, William Bay National Park, Mazzoletti track, *K.Syme 2847*, 2 June 2013, PERTH 8971692!; E of Albany, Two Peoples Bay Nature Reserve, Fitzpatrick's Track, *K.Syme 581/92*, 23 June 1992, PERTH 5306620!; E of Albany, Two Peoples Bay Nature Reserve, Wilson's track, *K.Syme 748/94 & M.Hart*, 22 June 1994, PERTH 5306108!; Albany, Two Peoples Bay Nature Reserve, along track to rubbish bins from research quarters, *K.Syme 210/91*, 2 July 1991,

Figure 2. a. Typical habitat of *Asproinocybe lyophylloides* sp. nov. Sclerophyll woodland with scrubby understorey; b–d. fruitbodies (b–c. MEL2432720; d. MEL2432747). Scale bars 10 mm.

PERTH 4163559!; Rockingham, Rockingham Lakes Regional Park, Port Kennedy Park, *N.L.Bougher & J.Froudist E8469*, 17 July 2007, PERTH 8093148!; Busselton, Geographe, Captain Baudins Reserve, *N.L.Bougher & D.Mead-Hunter E9348*, 28 June 2009, PERTH 8474370!; Cambridge, Ocean Village Reserve, City Beach, *N.L.Bougher 578*, 14 Sept 2009, PERTH 8474001!; Cambridge, Ocean Village Reserve, City Beach, *N.L.Bougher 1169*, 1 Aug 2015, PERTH 8700486!; Cockburn, Woodmans Point Regional Park, *N.L.Bougher, P.Davison, P. & R.Hart E8232*, 21 June 2005, PERTH 7680910!

***Habit, habitat and distribution*:** Typically fruits in small troops or solitary in shady, moist litter in open eucalypt woodlands with mixed understorey (*Allocasuarina*, *Eucalyptus cornuta*, *Agonis flexuosa*, *Spyridium globulosum*, *Lepidosperma* sp.), and rarely in mixed chenopod shrublands in hind dunes; often sandy soils.

***Notes*:** This species is quite widespread in southern Western Australia but is frequently misidentified in the field as a species of *Lyophyllum*.

Discussion

While the genus *Tricholosporum* has been examined and molecular data is available, sequences from species of other *Asproinocybe* are lacking for comparison, which unfortunately makes family level confirmation difficult, and confirmation of *Tricholosporum* as being distinct from *Asproinocybe* problematic. These two genera have variously been placed in Entolomataceae or Tricholomataceae (Guzman *et al.* 1990, 2004). Recent investigations into fungi of tropical areas has provided some insight into potential phylogenetic placement for a suite of tricholomatoid taxa. Sanchez-Garcia *et al.* (2016) raised the family Catathelasmataceae based on a multigene phylogeny

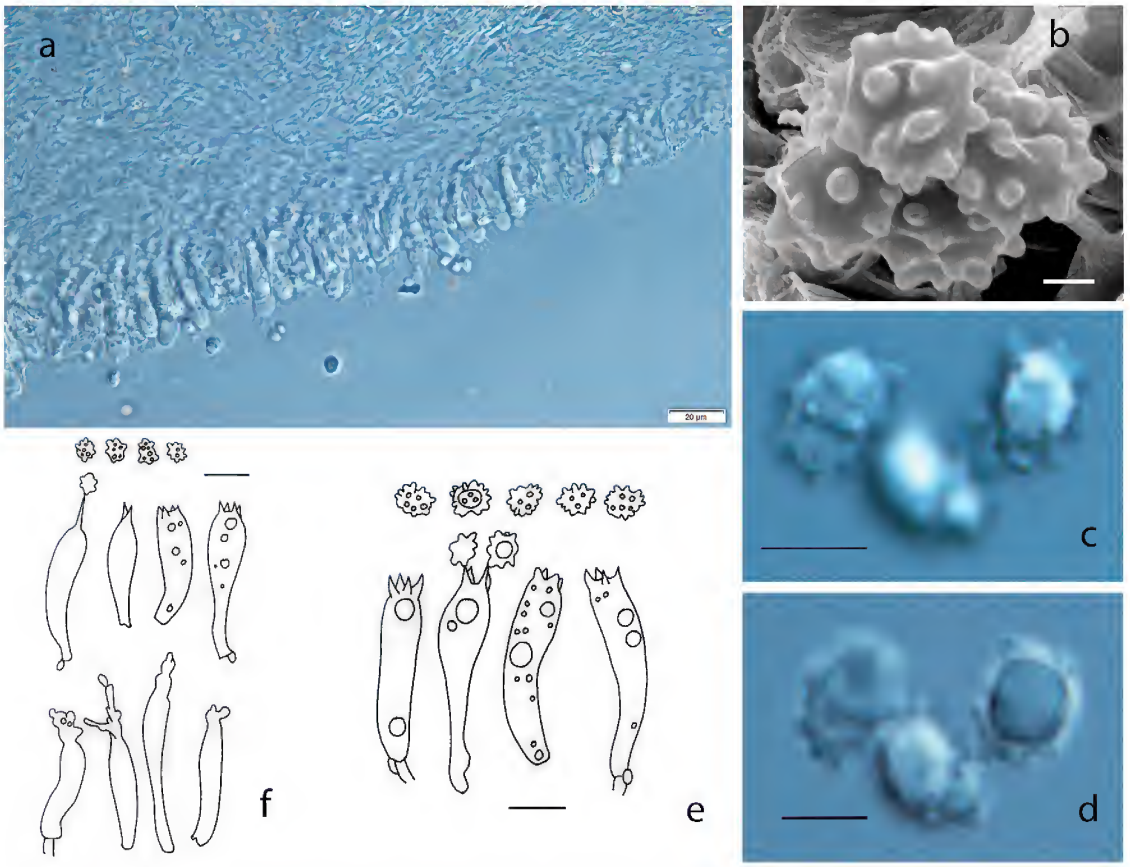

Figure 3. *Asproinocybe lyophylloides* sp. nov. a. hymenium and hymenial trama, scale bar 20 µm; b. SEM of spores; c–d light microscopy of spores. Scale bars 5 µm; e. line drawing of basidia and spores (K.Syme, a–e. MEL2292252); f. illustration of GB500 (MEL2382847) basidia, spores and cystidia (K. Syme). Scale bars = 10 µm.

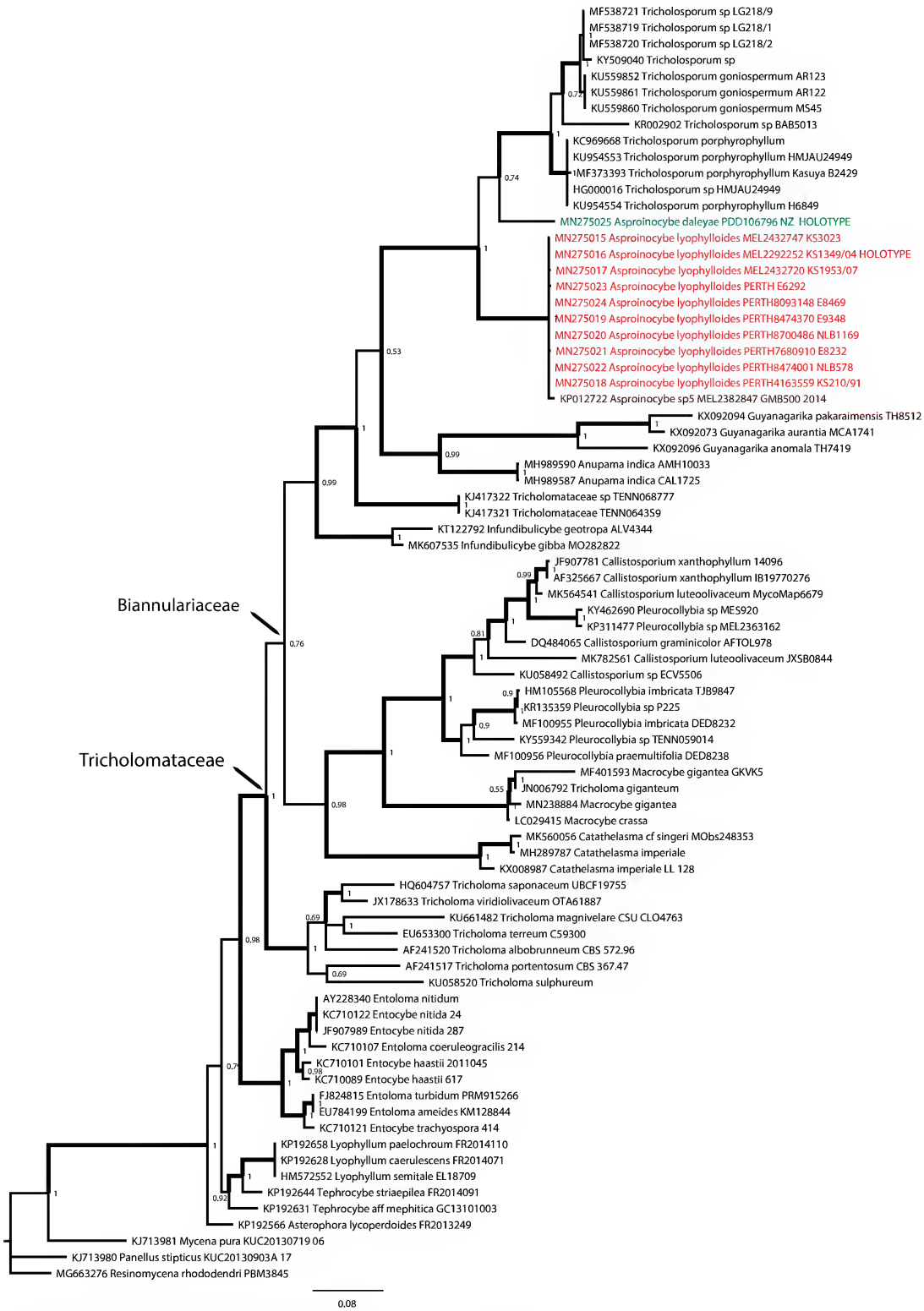
MF538721 Tricholosporum sp LG218/9
MF538719 Tricholosporum sp LG218/1
MF538720 Tricholosporum sp LG218/2
KY509040 Tricholosporum sp
KU559852 Tricholosporum goniospermum AR123
KU559861 Tricholosporum goniospermum AR122
KU559860 Tricholosporum goniospermum MS45
KR002902 Tricholosporum sp BAB5013
KC969668 Tricholosporum porphyrophyllum
KU954553 Tricholosporum porphyrophyllum HMJAU24949
MF373393 Tricholosporum porphyrophyllum Kasuya B2429
HG000016 Tricholosporum sp HMJAU24949
KU954554 Tricholosporum porphyrophyllum H6849
MN275025 Asproinocybe daleyae PDD106796 NZ HOLOTYPE
MN275015 Asproinocybe lyophylloides MEL2432747 KS3023
MN275016 Asproinocybe lyophylloides MEL2292252 KS1349/04 HOLOTYPE
MN275017 Asproinocybe lyophylloides MEL2432720 KS1953/07
MN275023 Asproinocybe lyophylloides PERTH E6292
MN275024 Asproinocybe lyophylloides PERTH8093148 E8469
MN275019 Asproinocybe lyophylloides PERTH8474370 E9348
MN275020 Asproinocybe lyophylloides PERTH8700486 NLB1169
MN275021 Asproinocybe lyophylloides PERTH7680910 E8232
MN275022 Asproinocybe lyophylloides PERTH8474001 NLB578
MN275018 Asproinocybe lyophylloides PERTH4163559 KS210/91
KP012722 Asproinocybe sp5 MEL2382847 GMB500 2014
KX092094 Guyanagarika pakaraimensis TH8512
KX092073 Guyanagarika aurantia MCA1741
KX092096 Guyanagarika anomala TH7419
MH989590 Anupama indica AMH10033
MH989587 Anupama indica CAL1725
KJ417322 Tricholomataceae sp TENN068777
KJ417321 Tricholomataceae TENN064359
KT122792 Infundibulicybe geotropa ALV4344
MK607535 Infundibulicybe gibba MO282822
JF907781 Callistosporium xanthophyllum 14096
AF325667 Callistosporium xanthophyllum IB19770276
MK564541 Callistosporium luteoolivaceum MycoMap6679
KY462690 Pleurocollybia sp MES920
KP311477 Pleurocollybia sp MEL2363162
DQ484065 Callistosporium graminicolor AFTOL978
MK782561 Callistosporium luteoolivaceum JXSB0844
KU058492 Callistosporium sp ECV5506
HM105568 Pleurocollybia imbricata TJB9847
KR135359 Pleurocollybia sp P225
MF100955 Pleurocollybia imbricata DED8232
KY559342 Pleurocollybia sp TENN059014
MF100956 Pleurocollybia praemultifolia DED8238
MF401593 Macrocybe gigantea GKVK5
JN006792 Tricholoma giganteum
MN238884 Macrocybe gigantea
LC029415 Macrocybe crassa
MK560056 Catathelasma cf singeri MObs248353
MH289787 Catathelasma imperiale
KX008987 Catathelasma imperiale LL 128
HQ604757 Tricholoma saponaceum UBCF19755
JX178633 Tricholoma viridiolivaceum OTA61887
KU661482 Tricholoma magnivelare CSU CLO4763
EU653300 Tricholoma terreum C59300
AF241520 Tricholoma albobrunneum CBS 572.96
AF241517 Tricholoma portentosum CBS 367.47
KU058520 Tricholoma sulphureum
AY228340 Entoloma nitidum
KC710122 Entocybe nitida 24
JF907989 Entocybe nitida 287
KC710107 Entoloma coeruleogracilis 214
KC710101 Entocybe haastii 2011045
KC710089 Entocybe haastii 617
FJ824815 Entoloma turbidum PRM915266
EU784199 Entoloma ameides KM128844
KC710121 Entocybe trachyospora 414
KP192658 Lyophyllum paelochroum FR2014110
KP192628 Lyophyllum caerulescens FR2014071
HM572552 Lyophyllum semitale EL18709
KP192644 Tephrocybe striaepilea FR2014091
KP192631 Tephrocybe aff mephitica GC13101003
KP192566 Asterophora lycoperdoides FR2013249
KJ713981 Mycena pura KUC20130719 06
KJ713980 Panellus stipticus KUC20130903A 17
MG663276 Resinomycena rhododendri PBM3845
Biannulariaceae
Tricholomataceae
0.08

Figure 4. Bayesian 50% majority-rule consensus tree of the ITS-nrDNA for a selection of Biannulariaceae, Tricholomataceae and Entolomataceae. Bold lines indicate PP support >0.95.

to include *Pleurocollybia*, *Callistosporium*, *Macrocybe*, *Guyanagarika*, *Pseudolaccaria* and *Catathelasma*. Angelini *et al.* (2017) and Raj *et al.* (2019) placed these taxa in the family Biannulariaceae (which has priority over Catathelasmataceae), based on analyses of ITS/LSU, and the addition of *Tricholosporum goniospermum* and the genus *Anupama*. None of these taxa have the nodulose or tuberculate spores of *Asproinocybe* and *Tricholosporum*.

Our current analysis, based on ITS alone, suggests poor support for Biannulariaceae, but strong support for a restricted Catathelasmataceae, or a broadly circumscribed Tricholomataceae (Fig 4). In this analysis there is strong support for a clade with *Infundibulicybe*, *Anupama*, *Guyanagarika*, Tricholomataceae sp, *Asproinocybe* and *Tricholosporum* as sister to Catathelasmataceae. However, in a restricted multigene analysis of a broad selection of taxa from Lyophyllaceae, Entolomataceae and Tricholomatoid agarics based on Sanchez-Garcia *et al.* (2016) and Hofstetter *et al.* (2014), there was poor support for placement of *Asproinocybe* and *Tricholosporum* in a broad Tricholomataceae (not presented). This analysis emphasised the need for the generation of multigene data for a range of 'residual tricholomatoid' taxa to resolve relationships amongst these lineages.

The relationship between *Tricholosporum* and *Asproinocybe* will remain problematic until further species of *Asproinocybe* are sequenced. *Asproinocybe lyophylloides* has more muted hints of purple in the pileus and lamellae than *A. daleyae*, or indeed most other species, and spores at the smaller end of the size range for *Asproinocybe*. *Asproinocybe daleyae* differs in its production of distinct cheilo- and pleuro-cystidia.

We do not include the Northern Territory collection (GB500, MEL2382847!) in *Asproinocybe lyophylloides* at this time, even though there are very few base pairs (8bp) difference in the ITS sequences, and morphologically only minor and subtle differences in colouration and texture of basidiomata. It does differ microscopically in spore size (GB500 spores smaller: from 4.8–5.9 × 3.0–4.8 µm), its mostly one- and two-spored versus 4-spored basidia, and its abundant and distinctive cheilo- and pleuro-cystidia, which are completely absent in *A. lyophylloides* (Fig 3f). This Northern Territory collection (GB500) is immature, and it would be preferable to have more material to confirm both macromorphology and spore characters in particular. Given the large geographic distance between the south-west of Western Australia and the Northern Territory, we consider GB500 likely to represent a different species, perhaps one more closely related to the tropical Malaysian species *A. superba*. However, *A. superba* has more robust and much darker basidiomata and lamellae than GB500, being entirely violaceous-black with hints of purple chestnut or violaceous brown with dark grey-violet lamellae, rather than greyish brown with hints of violet and pale greyish violet lamellae. Microscopically,

Table 1. List of material sequenced for this study. Supplementary electronic data in the form of a Nexus file is provided in association with the online issue of this paper.

Taxon	Herb#	Country	GenbankITS	Genbank LSU
Asproinocybe daleyae	PDD 106796	New Zealand	MN275025	MN275033
Asproinocybe lyophylloides	MEL2432720	Australia	MN275017	MN275026
Asproinocybe lyophylloides	PERTH 4163559	Australia	MN275018	MN275027
Asproinocybe lyophylloides	MEL2432747	Australia	MN275015	MN275028
Asproinocybe lyophylloides	MEL2292252	Australia	MN275016	MN275029
Asproinocybe lyophylloides	PERTH 8477001	Australia	MN275022	MN275030
Asproinocybe lyophylloides	PERTH E6292	Australia	MN275023	MN275031
Asproinocybe lyophylloides	PERTH 8093148	Australia	MN275024	MN275032
Asproinocybe lyophylloides	PERTH 8474370	Australia	MN275019	-
Asproinocybe lyophylloides	PERTH 8700486	Australia	MN275020	-
Asproinocybe lyophylloides	PERTH 7680910	Australia	MN275021	-
Asproinocybe lyophylloides	PERTH 8474001	Australia	MN275022	-

the basidia and basidiospores are similar in size (though the ornamentation of *A. superbum* spores appear to be less obvious than in GB500), and the presence of some poorly differentiated scattered cheilo- and pleuro-cystidia (Watling 1997). Further collections and molecular data should clarify this situation.

Acknowledgements

Many thanks to herbarium staff at MEL, AD and PERTH, in particular research assistant Gareth Holmes for sequencing of Australian material. J.A. Cooper would like to thank Duckchul Park for sequencing of New Zealand material and Wanda Daley for provision of specimens and photographs. J.A. Cooper is supported with funding from the Science and Innovation Group of the New Zealand Ministry of Business, Innovation and Employment. Katrina Syme was supported by the Royal Botanic Gardens Victoria, ABRS grant (RFL217-63), and T. Lebel for a two week internship to conduct taxonomic research on several species of fungi as part of a citizen science mycotaxonomy project.

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Published online in advance of the print edition, 17 February 2020

ROYAL BOTANIC GARDENS VICTORIA

Acacia cineramis (Leguminosae: Mimosoideae), a new species endemic to south-eastern Australia, and an investigation of phyllode nervature in allied species

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Introduction

The genus *Acacia* Mill. (Leguminosae: Mimosoideae) is an iconic plant group of the Australian flora and, consisting of over 1050 currently recognised species (Maslin 2015), is also the largest angiosperm genus in the country. *Acacia rigens* A.Cunn. ex G.Don is a relatively widespread species found in all states except Tasmania, growing mainly on sandy and shaly soils in mallee scrub (Cowan 2001). It commonly extends from the Gawler Ranges, South Australia (S.A.), through north-western Victoria (Vic.) to Dubbo, New South Wales (N.S.W.). Occurrences of the species outside this range are scattered, with disjunct populations occurring in southern Western Australia (W.A.), the Northern Territory (N.T.) and southern Queensland (Qld) (Cowan 2001, 2018; AVH 2018). It is typically a spreading shrub to 3 m high or (occasionally) a tree to 6 m high, with straight to shallowly incurved, terete or sometimes flat plurinerved phyllodes 3–14 (–16) cm long and 0.8–3 mm in wide. Historically, the species has been regarded as a member of section *Plurinerves* (Pedley 1978); however, a more recent molecular study by Murphy *et al.* (2010)

Abstract

A morphometric multivariate analysis of *Acacia rigens* A.Cunn. ex G.Don and an entity previously recognised as *Acacia* sp. Gerang Gerung (M.G.Corrick 6451) was conducted, with the latter described here as a new species, *Acacia cineramis* H.K.Orel. This new species is considered endangered in accordance with IUCN classification, and known populations occur only in the Wimmera region of central-western Victoria. A preliminary assessment of phyllode anatomy, focusing on phyllode nervature, in *A. cineramis* and related species is also presented.

***Keywords*:** Wimmera, Wattle, endangered, multivariate analysis, phyllode anatomy, vasculature

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ISSN: 0077-1813 (print) • ISSN: 2204-2032 (online)

established that the sectional classification of the genus warranted revision, and that section Plurinerves was not monophyletic. As such, *A. rigens* was placed within a diverse group of taxa informally termed the 'p.u.b. clade' as a member of 'subclade E1' with six other taxa that mostly share narrow, sclerophyllous phyllodes and which occur in arid to semi-arid areas (Murphy *et al.* 2010). A larger phylogenetic study (Mishler *et al.* 2014) found a similar result, and resolved *A. rigens* in a clade sister to *A. enterocarpa* R.V.Sm. and *A. hexaneura* P.Lang & R.S.Cowan.

Prior to the current study, a number of specimens in the National Herbarium of Victoria (MEL), previously identified as *Acacia rigens,* had been noted to differ morphologically from typical *A. rigens* and were collectively given the informal name *Acacia* sp. aff. *rigens* (Gerang Gerung) (hereafter referred to as *A.* 'Gerang Gerung') in reference to the area from which several of the specimens were collected. The taxon is listed in APNI (CHAH 2006) as *Acacia* sp. Gerang Gerung (M.G.Corrick 6451) Vic. Herbarium. From herbarium records, the distribution of *A.* 'Gerang Gerung' extends approximately from the town of Dimboola, through Gerang Gerung and Nhill to just north of Kaniva near the South Australia-Victoria border. Specimens of *A.* 'Gerang Gerung' were principally distinguished from *A. rigens* by a number of morphological differences in characters of the branchlets, phyllodes, peduncles and inflorescences (VicFlora 2018). However, the degree of differentiation between these features was not thoroughly defined, and it was not certain that the distinguishing characters were appropriate to justify the recognition of *A.* 'Gerang Gerung' as a different taxon to *A. rigens*.

Accordingly, a morphometric analysis of specimens of *A. rigens* and *A.* 'Gerang Gerung' was undertaken in order to examine the morphological variation between the two putative entities and assess the taxonomic status of *A.* 'Gerang Gerung'. The analysis also presented an opportunity to conduct an examination of morphological variation in *A. rigens* across its range.

Phyllode nerve anatomy and classification in *Acacia*

Acacia phyllodes have an anatomical structure that is unique amongst angiosperms, in particular in the way vascular tissue (commonly referred to in *Acacia* as 'veins' or, as used in this study, 'nerves') is arranged (Gardner *et al.* 2008). It has long been recognised that the arrangement and number of nerves is a key character for the taxonomy and classification of *Acacia* (Boughton 1986), and there have been a number of studies on the physiological function and development of phyllodes and these nerves (e.g. Boughton 1990; von Wartburg 1991; Brodribb and Hill 1993; Sommerville *et al.* 2012). However, there has been relatively little assessment of the phylogenetic implications of phyllode nervature beyond the broad categories of 'uninerved' versus 'plurinerved' that have been traditionally used to define sections in the classification of the genus. Given that there has been a recent overhaul of the phylogenetic understanding of *Acacia* in comparison to the traditional sectional classifications (Pedley 1978; Murphy *et al.* 2010), the understanding of phyllode anatomy is possibly highly significant, as differences in nerve arrangement among taxa thought to be closely related to *A.* 'Gerang Gerung' may assist in clarifying species boundaries, and help identify possible phylogenetic characters for use in assessing deeper phylogenetic relationships in *Acacia*. For this reason, a descriptive survey of phyllode anatomy was conducted, with an emphasis on recording any diagnosable differences in phyllode nervature between established and putative species.

Methods

Sampling

In total, 70 specimens were assessed in this study, with each specimen considered as a single operational taxonomic unit (OTU). Sixty herbarium specimens, housed in the National Herbarium of Victoria (MEL), were included from across the range of *Acacia rigens* (see Figure 1). Of these, 15 were previously identified as *A.* 'Gerang Gerung' and 45 were considered *A. rigens*. In addition, 10 fresh collections (eight of *A.* 'Gerang Gerung' and two *A. rigens*) were made to supplement the previously existing herbarium material and to enable comparison between fresh and dried specimens. Notably, these represent the first collections of *A.* 'Gerang Gerung' made in more than 30 years. All supplementary specimens have been lodged at MEL.

Morphometric characters

Ultimately, 26 morphological characters were used in this study (Table 1) based, in part, on characters utilised

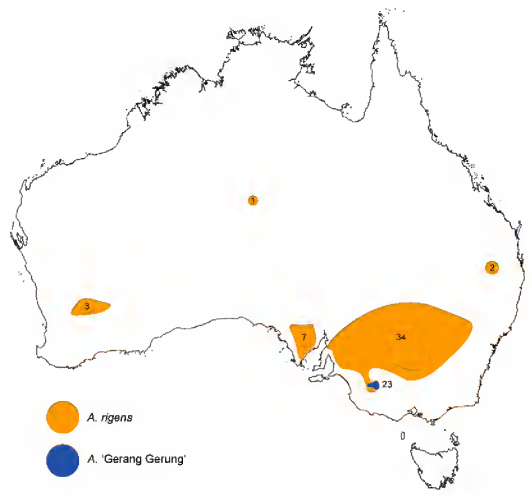

Figure 1. Map of Australia displaying the collection locations of *Acacia rigens* and *Acacia* 'Gerang Gerung' (now *Acacia cineramis*) specimens used in this study. Numbers inside or adjacent to coloured regions indicate the number of specimens from that region.

in identification keys for the delineation of *Acacia* species closely related to, or resembling *A. rigens*, as well as those characters informally employed to distinguish the subject taxa in the past (VicFlora 2018). Also included were some new characters observed to differ between the entities during the course of this study. The characters assessed can be segregated into four broad categories based on anatomy: branchlet, phyllode, inflorescence and pod characters. For each specimen, where possible, four measurements were taken for all phyllode, inflorescence and pod characters and used to calculate a mean value for each character which was utilised in our analysis. Due to the predominantly binary nature of the branchlet characters used, specimens were scored only once for each branchlet character. Seed characters were initially scored, however, it was ultimately considered that there were too many specimens with missing data for these characters, so they were excluded from the analysis. Reasons for the inclusion of the morphological characters are provided, with bracketed numbers corresponding to the character numbers listed in Table 1.

Branchlet characters

Several differences in features of the branchlet had previously been noted between *Acacia rigens* and *A.* 'Gerang Gerung'. Branchlet cross-sectional shape had been principal in the differentiation of the two entities (1). *Acacia* 'Gerang Gerung' was described as having more or less terete branchlets and obscure ribs, whilst *A. rigens* was noted to have strongly ribbed branchlets (VicFlora 2018; Maslin 2018). Although less clear, the nature of the branchlet indumentum was also identified as a possible delimiting character (2, 3, 4, 5); *A. rigens* was thought to possess shorter hairs, with the indumentum absent on branchlet ribs (NGW pers. obs.; VicFlora 2018).

Phyllode characters

Noted features of difference in the phyllodes between *Acacia* 'Gerang Gerung' and *A. rigens* were centred mainly around nervature (12, 13) and features of the indumentum (14, 15). The former was described as possessing eight distinct main nerves (Maslin 2018), while the latter was described as possessing multistriate (many fine nerves) nervature (Cowan 2001, 2018). Additionally, it was observed that the main nerves of *A. rigens* were less raised (Maslin 2018), with appressed-puberulous hairs (Cowan 2018), whereas *A.* 'Gerang Gerung' was noted to have distinctly sub-appressed hairs (VicFlora 2018). To account for differences in plant and phyllode maturity, phyllodes were measured for length, diameter and angle (6.5 mm along the phyllode from the node) at the seventh node from the mature distal phyllode (7, 9 and 10 respectively).

Inflorescence characters

Features of the inflorescence have long been used for the division of groups and species in *Acacia* (Bentham 1875; Pedley 1986; Maslin 2014; Maslin & Barrett 2014). Both the nature of the peduncle indumentum (17, 18) and number of flowers per capitulum (19) had proven useful for the separation of *Acacia rigens* from *A.* 'Gerang Gerung' in the past (VicFlora 2018; Maslin 2018).

Multivariate analyses

Ordination and cluster analyses were conducted in the PATN for Windows software v.3.02 (Belbin & Collins 2004) using our morphological data as input to assess the overall similarities and differences of each OTU. Range-standardisation was performed using the '(Value-Minimum Value) Range of Value' setting prior to the creation of a distance matrix, produced using the Gower metric association measure (Gower 1971). Cluster analysis was performed using the flexible unweighted

pair-group method with arithmetic mean (UPGMA) to construct a dendrogram. A semi-strong hybrid and multidimensional scaling (SSH MDS) ordination was conducted on the dataset, employing 50 random starts and 200 maximum iterations for the examination of the relative positions of OTUs in three-dimensional space. Kruskal-Wallis (KW) values were calculated for assessment of the significance of individual characters in the analysis, where a higher KW value indicates a greater contribution to group differentiation.

Survey of phyllode anatomy

Phyllode material taken from herbarium specimens was rehydrated for one day in water with a small amount of detergent added. Transverse hand sections were made from the mid-point of the phyllodes length and the sections were mounted using a basic wet mount. In total, five species were included in the survey, selected primarily on the current understanding of phylogenetic relationships of *Acacia rigens* (Mishler *et al.* 2014). Species selected on this basis were: *A.* 'Gerang Gerung', *A. rigens*,

Table 1. Twenty-six morphological characters scored from herbarium specimens for the current study.

	Branchlet characters
1.	Slightly ribbed (0) or strongly ribbed (1)
2.	Indumentum covering ribs (0) or between ribs (1)
3.	Indumentum density: moderate (0) or dense (1)
4.	Hair length minimum (mm)
5.	Hair length maximum (mm)
	Phyllode characters
6.	Pulvinus length (mm)
7.	Length of phyllode at 7th node (mm)
8.	Length of longest phyllode (mm)
9.	Diameter of phyllode (mm)
10.	Phyllode angle from stem at 6.5mm from node (degrees)
11.	Shape in cross-section: flat to compressed (0) compressed to subterete (2) subterete (3) subterete to terete (4) terete (5)
12.	Nerve number
13.	Nerves equal (in size, width and raising) (0) or some less prominent (1) (viewed under stereo microscope)
14.	Internerve indumentum: absent (0) sparse (1) moderate (3) dense (4)
15.	Primary nerve indumentum: glabrous (0) sparse (1) sparse to moderate (2) moderate (3)
	Inflorescence characters
16.	Peduncle length at anthesis (mm)
17.	Peduncle indumentum density: glabrous (0) glabrous to sparse (1) sparse (2) sparse to moderate (3) moderate (4) moderate to dense (5) dense (6)
18.	Peduncle indumentum: appressed (0) subappressed (1) hirsute (2)
19.	Number of flowers per capitulum
20.	Capitulum diameter at anthesis (mm)
21.	Bud shape: galeiform (0) elliptic (1) elliptic to ogive (2) ogive (3)
	Pod characters
22.	Length (mm)
23.	Width at narrowest point (mm)
24.	Width at widest point (mm)
25.	Distance between seeds (mm)
26.	Shape: submoniliform and curved (0) or submoniliform and curved to coiled (1)

A. enterocarpa and *A. calcicola*. Along with these species, *A. havilandiorum* was included to provide outgroup comparison and because of its superficial morphological similarity to *A.* 'Gerang Gerung' and *A. rigens*.

Results

Multivariate analyses

The dendrogram produced by cluster analysis resolved two clear groups consistent with our *a priori* hypothesis of the classification specimens into *A.* 'Gerang Gerung' and *A. rigens* (Figure 2). The separation of these groups was consistent in our ordination and was resolved with a stress value of 0.0885. For this method of ordination, any stress value less than 0.1 corresponds to a good representation of the data in ordination space, with no real prospect of drawing false inferences (Clarke 1993). Groups in the ordination were definitively isolated from one another across every dimension in multidimensional space (Figure 3).

Throughout the course of this study it was observed that a broad, flat phyllode variant of *A. rigens* exists from the Eyre Peninsula, S.A. Along with this, specimens from this region were noted to possess a greater number of nerves per phyllode. These individuals formed a group in the dendrogram (MEL2365638A, MEL0500676A, MEL0682135A, MEL1582539A, MEL0500677A) clustered within *A. rigens*. Further investigation of this group was beyond the scope of the present study, but a study incorporating more specimens from this area is proposed.

Survey of phyllode anatomy

Based on the characters illustrated from phyllode transverse sections (Figure 4), *Acacia* 'Gerang Gerung' bears most similarity to *A. enterocarpa,* and not *A. rigens* with which it was previously included. *Acacia rigens* possesses subsidiary nerves which, along with main and minor nerves, bring its nerve number to over 30. *Acacia* 'Gerang Gerung' and *A. enterocarpa* display 15 and 16 nerves respectively (including subsidiary nerves). These subsidiary nerves

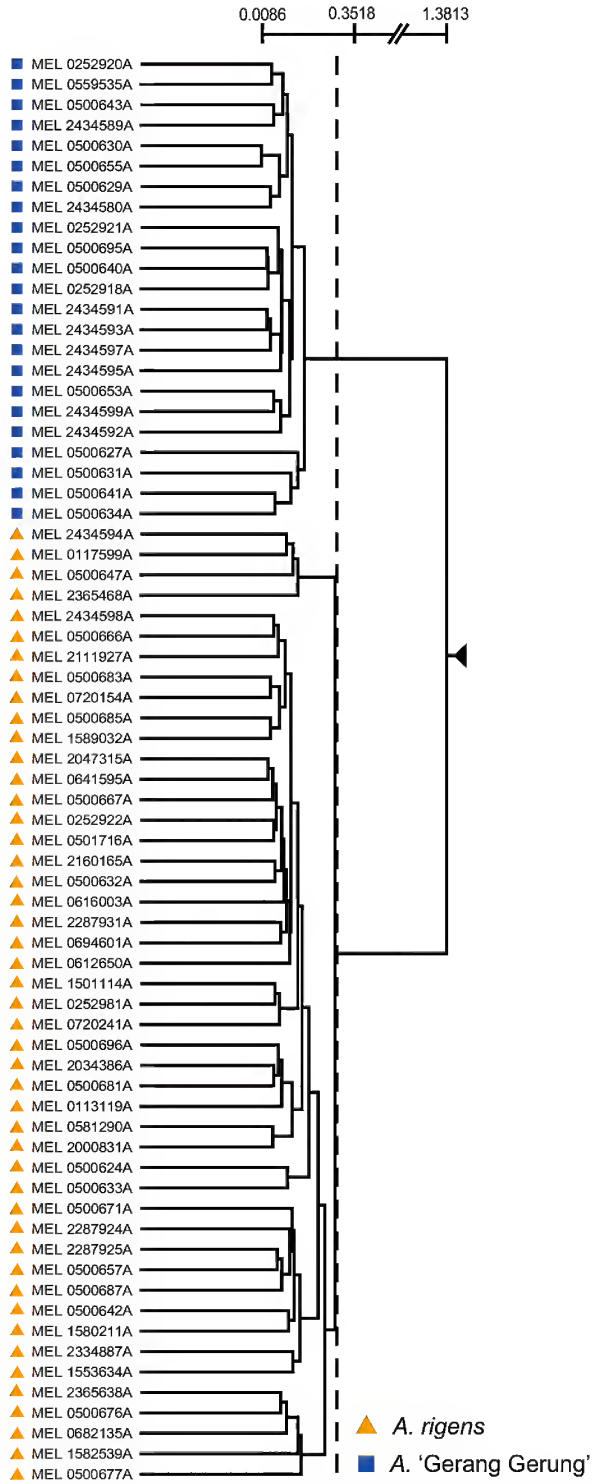

Figure 2. Dendrogram produced from analysis of *Acacia* 'Gerang Gerung' (*Acacia cineramis*) and *Acacia rigens* based on 26 characters. Scale of relative distance has been adjusted for publication (indicated by // on scale bar). MEL numbers provided as per AVH database entry.

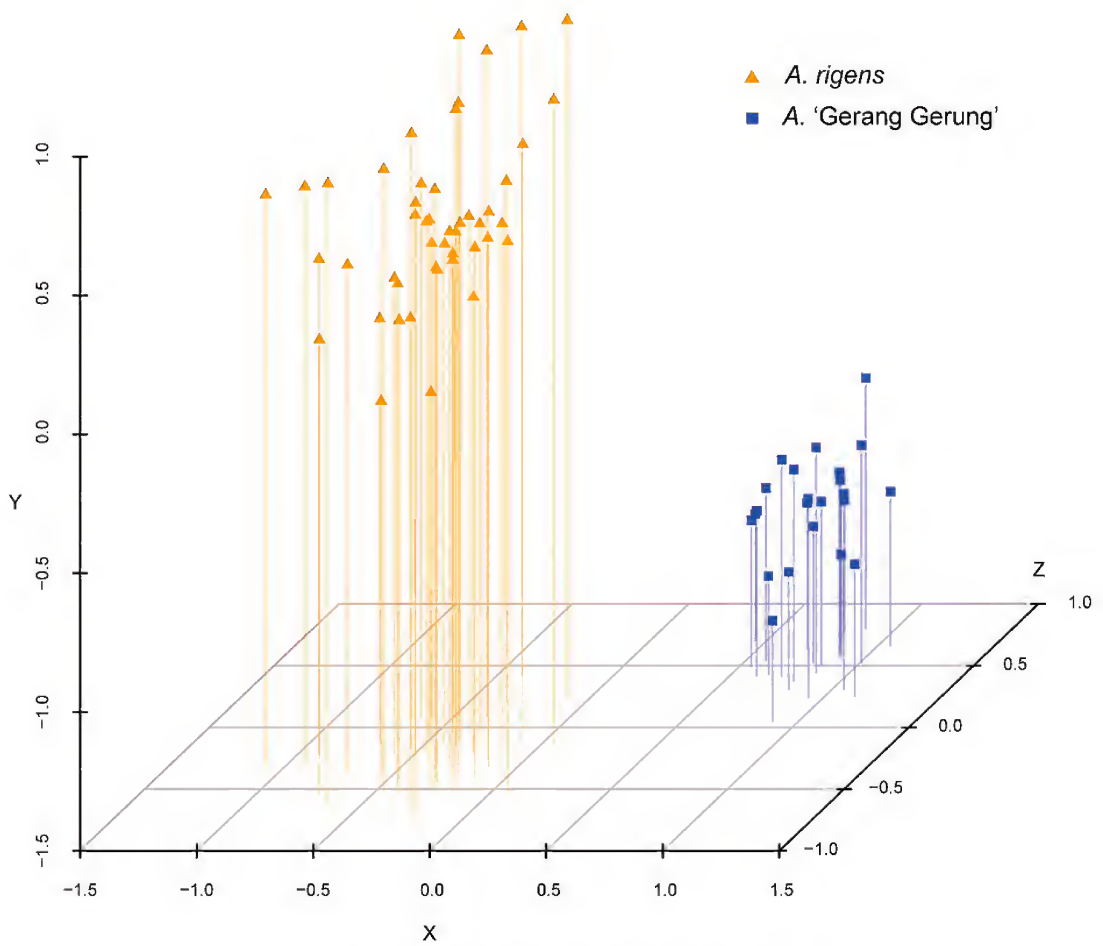

Figure 3. Three-dimensional ordination of all specimens included in study. Vertical drop lines are included to provide greater visualisation of spacing on the X-Z plane.

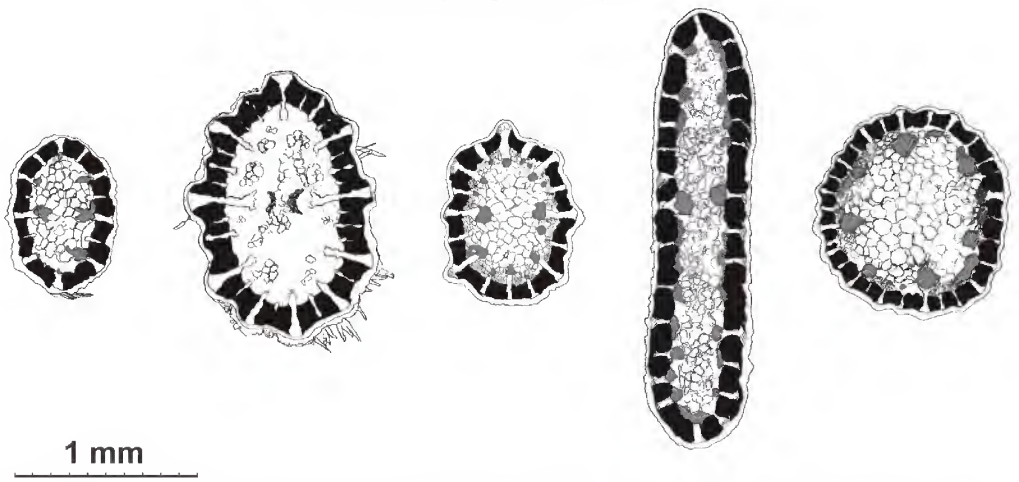

Figure 4. Illustrations of transverse section of phyllodes showing palisade mesophyll (black) and vascular bundles (grey). Species are arranged by relatedness according to Mishler *et al*. (2014); (left to right) *Acacia cineramis*, *A. rigens*, *A. enterocarpa*, *A. calcicola*, *A. havilandiorum*.

appear undeveloped, are unobservable by eye or stereo microscope and do not connect to vascular bundles located in the spongy mesophyll (see *A.* 'Gerang Gerung' under *A. cineramis* in Figure 4). Aside from being significantly larger and more developed, nerves that are visible by eye and stereomicroscope generally abut vascular bundles within the spongy mesophyll.

Discussion

Given the consistency and extent of the separation between *Acacia rigens* and *A.* 'Gerang Gerung' in our analyses, as well as the long-standing acknowledgement of morphological discrepancies between the two entities, we consider it appropriate to propose the formal taxonomic recognition of *A.* 'Gerang Gerung' as a new species. This treatment is reflective of the level of morphological differentiation between *A.* 'Gerang Gerung' and *A. rigens* which is consistent with, if not greater than, the degree of morphological variation that has justified the designation of other new *Acacia* species (e.g. Maslin & Thomson 1992; Maslin 2014).

Kruskal-Wallis scores indicated that the most important characters for the delineation of groups were largely in line with the differentiating characters identified prior to this study, however, several novel characters have been discovered as useful (Table 2). Of these, phyllode nerve equality (character 13, KW: 69) was revealed as a key character in distinguishing the two species. All of the included pod characters produced statistically insignificant KW values, suggesting little difference in the fruits of the species. However, this result may be attributed to the limited availability of pods in the specimens used for analysis; only 26 out of 70 specimens included enough material for measuring pod characters. It is worth noting that some of the best characters for separating the species in the field received lower than expected KW scores due to small amounts of missing data. For example, character 19 (number of flowers per capitulum) was measured as discontinuous for both species (*A.* 'Gerang Gerung' possesses a maximum of 14 flowers per capitulum whilst *A. rigens* possesses a minimum of 20), however, the significance of this character in terms of KW value was lessened (KW: 26.5) by the fact that the character could not be measured for 22 out of 76 specimens. For this reason, KW values should not be taken as a definitive indicator of the usefulness of a character, and pod characters should not be dismissed as entirely uninformative; the collection of more pod data may reveal further differences between the species. Additionally, considering cases where *Acacia* species have been resolved as polyphyletic in molecular analyses (Brown *et al.* 2010), the relatively high level of morphological differentiation between *A.* 'Gerang Gerung' and *A. rigens* presents an appealing case for a molecular comparison of the two species in the future, as we hypothesise that these two taxa may not be sister species but rather each may be more closely related to other taxa.

Table 2. Ten highest Kruskal-Wallis (KW) values across all scored characters used in the multivariate analyses. 'Used historically' denotes whether the character was used to distinguish *Acacia* 'Gerang Gerung' (*Acacia cineramis*) from *Acacia rigens* prior to this study.

Character	KW value	Used historically
13.	69.0	No
1.	69.0	Yes
2.	65.3	Yes
15.	63.6	Yes
14.	58.4	Yes
18.	51.7	Yes
12.	48.2	Yes
8.	43.8	No
7.	42.9	No
21.	31.1	No

The new species previously referred to as *Acacia* 'Gerang Gerung' is hereafter referred to as *Acacia cineramis*. The description of this new species is based on the measurements and scoring used for multivariate analyses in this study. Outlying measurements are denoted by brackets.

Phyllode nervature

Much of what is known about nerve development in *Acacia* phyllodes has been derived through morphometric taxonomic investigations and consists predominantly of observed trends in small subject groups (Gardner *et al.* 2005). This makes the application of these hypotheses across wider groups difficult, especially given the extent of variability and likely homoplasy identified in a large genus such as *Acacia* (Murphy *et al.* 2010). One hypothesised correlation

highlighted by Gardner *et al.* (2005) is between phyllode breadth and longitudinal nerve number in plurinerved species, where broader phyllodes possess a greater number of nerves (Boke 1940; Pedley 1978). Upon initial observation this relationship appears consistent with the variation observed during this study in *Acacia rigens* on Eyre Peninsula, however, further study is required to confirm if this is indeed the case.

Potentially the most notable observation made among species examined was the presence of undeveloped subsidiary nerves between developed nerves in *Acacia cineramis*, *A. rigens* and *A. enterocarpa* (Figure 4) which are unobservable by eye or under stereomicroscope. For example, *A. enterocarpa* displays 16 nerves in transverse section despite displaying only 10–12 visible nerves under stereomicroscope (as described in Cowan & Maslin 2018). These findings may be the result of within-species variation, however, it is more likely that there is an overall disconnect between 'visible nerve number' (i.e. the total number of nerves countable by eye or with a stereomicroscope) and 'actual nerve number' (i.e. the total number of nerves countable from phyllode transverse sections viewed under a compound microscope) for these species. Visible nerve number has long been used as a character for distinguishing various groups in *Acacia* with varying degrees of success. These results suggest that, as visible and actual nerve number do not necessarily align, considering only visible nerve number in the assessment of taxonomic groups and evolutionary relationships in *Acacia* may be insufficient and provide misleading taxonomic signals. Instead, both of these nerve number characters should be used in conjunction to provide a more accurate assessment of phyllode nervature in comparisons between groups, especially where the application of visible nerve number on its own is limited. In particular, consideration of subsidiary nerves may allow greater understanding of phylogenetic groupings of species in the 'plurinerved' clades of *Acacia* and perhaps provide additional morphological characters useful for distinguishing these clades, which to date have had limited morphological synapomorphies identified (Murphy *et al.* 2010). The mapping of both actual nerve number and visible nerve number onto molecular phylogenies at a broad scale has the potential to reveal possible patterns in phyllode nervature that have so far been unidentified, which may in turn assist in further resolving relationships in the genus.

The shared similarity in nervature between *Acacia cineramis* and *A. enterocarpa* suggests a closer relationship between these two species than was originally thought and is further supported by the similarity of their stem and indumentum morphology, where *A. cineramis* is more similar to *A. enterocarpa* than to *A. rigens*, although the very stiff, conspicuously pungent phyllodes and the very distinctive flexuose fruit of *A. enterocarpa* clearly separate it from both *A. cineramis* and *A. rigens*. A molecular study of the relationships of these three species would enable the assessment of the hypothesis that *A. cineramis* is more closely related to *A. enterocarpa* than to *A. rigens* and, in turn, prove useful in assessing 'actual nerve number' as a character and concept. It is notable that in Victoria *A. enterocarpa*, like *A. cineramis*, is restricted to the Wimmera, with some populations being within 2 km of each other near Sandsmere.

Patterns in phyllode nervature possess remarkable potential for contributing to the morphological delineation of groups within *Acacia*, yet remain poorly understood due to the evolutionary complexity of the genus and the lack of a comprehensive body of work dedicated to the study of phyllode nerves. Our investigation into phyllode nervature should be considered preliminary in nature and serves to act as an expansion on the existing literature that focuses on the connection between phyllode nervature and taxonomy (e.g. Boke 1940; Boughton 1986; Gardner *et al.* 2005, 2008). It is hoped that this work may assist in informing future studies of phyllode nervature, such as anatomical surveys, which hold significant promise for *Acacia* taxonomy.

Taxonomy

Acacia cineramis H.K.Orel, **sp. nov.**

Acacia sp. aff. *rigens* (Gerang Gerung), Ross & Walsh (2003)

Acacia sp. Gerang Gerung (M.G.Corrick 6451) Vic. Herbarium, CHAH (2006)

***Type*: AUSTRALIA**. Victoria. Gerang Gerung, north of railway line. Small bushland reserve surrounded

by farmland, 5 October 1979, *M.G. Corrick 6451* (holo: MEL559535, iso: PERTH 00681482)

Spreading, sometimes erect single or multi-stemmed *shrub* 1–2 m high, 0.8–4 m wide; *branchlets* resinous, ±terete, slightly ribbed by excurrent ridges from phyllode bases (typically 3 ridges per phyllode), covered uniformly by an indumentum of white, appressed hairs 0.1–0.4 mm long. *Phyllodes* widely spreading, subterete to terete, shallowly incurved, (1–)2–4.5(–6.5) cm long, (0.6–) 0.8–1 mm wide, slaty-green (new growth bronze-green), apex acute, but hardly pungent, usually slightly asymmetric; distinctly 8-*nerved* (visible by eye or stereo microscope), nerves equal and raised (more so when dry) with sparse to moderate subappressed hairs like those of branchlets, the distinct nerves interspersed with indistinct subsidiary nerves (visible only under magnification in transverse section); *internerves* longitudinally grooved (more so when dry), mostly glabrous; gland basal, indistinct; *pulvinus* c. 1.2 mm long. *Inflorescences* simple, (1–)2(–4) per axil; *peduncles* 1.5–2(–3) mm long, indumentum of dense subappressed to spreading white hairs; *basal bracts* spathulate, indumentum subappressed-puberulous; *heads* globular, 2–5 mm diam., 10–14-flowered, yellow. *Buds* resinous, galeiform to ellipsoid. *Flowers* 5-merous; petals ovate, 1.3–1.5 mm long, glabrous, free; sepals obovate, 0.7–0.8 mm long, fimbriate distally, sometimes with a few appressed hairs, very shortly fused at base (for <0.05 mm). *Pods* submoniliform, curved to loosely coiled, 2–4 cm long, 0.7–2 mm wide, chartaceous to coriaceous, indumentum of sparse to moderately dense, appressed, white hairs. *Seeds* longitudinal, elliptic, 1.8–3 mm long, 1–1.6 mm wide, glossy, brown; *aril* white, apical, conical, 0.6–2 mm long.

***Specimens examined*: VICTORIA**. Near Coker Dam, 29.ix.1895, *F.M. Reader s.n.* (MEL500655); Near Coker Dam, 29.xii.1895, *F.M. Reader s.n.* (MEL500641); Near Coker Dam, 29.xii.1895, *F.M. Reader s.n.* (MEL500630); Mallee District, x.1899, *St. E. D'Alton s.n.* (MEL500629); Dimboola, Wimmera, 12.xi.1899, *St. E. D'Alton 4* (MEL, AD); Dimboola, xi.1905, *St. E. D'Alton 255* (MEL); Jeparit-Lorquon, ix.1945, *A.C. Beauglehole 39851* (MEL); Big Desert, Parish of Murrawong, West Wimmera, 27.ix.1957, *A.J. Hicks s.n.* (MEL500634); Near Gerang [Gerung], 5.x.1957, collector unknown (MEL500640); Sandsmere Roadside Reserve, *A.C. Beauglehole 84095* (MEL); Cattle Dam Bushland Reserve, 16.ix.1986, *A.C. Beauglehole 84494* (MEL); Crown land adjacent to allotment 51, Parish Woraigworn, 10 km S of Gerang [Gerung], 13.ix.1987, *C. Brownsea s.n.* (MEL252920); Sandsmere, 19.xii.2018, *H.K. Orel 1* (MEL); Sandsmere, 19.xii.2018, *H.K. Orel 3* (MEL); North of Little Desert, *H.K. Orel 5* (MEL); Little Desert NP northern edge, 20.xii.2018, *H.K. Orel 7* (MEL); Gerang Gerung, 20.xii.2018, *H.K. Orel 9* (MEL); Glenlee, 20.xii.2018, *H.K. Orel 11* (MEL); **SOUTH AUSTRALIA**. Murray Bridge, 17.x.1953, *R.I.M. Humphrey s.n.* (AD 98534178).

***Distribution and ecology*:** Known only from extant populations in the Wimmera district of central-western Victoria. Historically recorded from Dimboola as far north as Lake Hindmarsh, with one outlying specimen recorded from Murray Bridge in South Australia (*R.I.M. Humphrey s.n.*, 1953, AD98534178). It is possible that the species' range extends, or once extended, that far west, however, the taxon was propagated at Wail nursery in the early 1950s (VicFlora 2018) and it is equally likely that this specimen was planted. Another outlying specimen recorded from the Big Desert Wilderness Area (*A.J. Hicks s.n.*, 1957, MEL500634) has not been confirmed by any recent collections and the record may be questionable. Surveys undertaken as part of this study were conducted in Victoria and have recorded the species from seven sites across an area of approximately 1145 kilometres bounded by the Little Desert to the south, Kaniva to the east, Gerang Gerung to the west and Glenlee to the north. The largest known population (~2500 individuals) occurs just inside the Eastern Block of Little Desert National Park while another significant population (>300 individuals) occurs within Glenlee Flora and Fauna Reserve. Population numbers in the five other sites from which it is currently known are very low (fewer than 15 individuals across all sites).

Acacia cineramis favours sandy clay loam soils overlying Tertiary Loxton Sand and is a co-dominant species in the two communities where its population is significant. From its current distribution and ecology, it seems likely that the species was distributed throughout the relatively fertile soils of the Wimmera and its range was bound in the north and south by the Big Desert and Little Desert respectively. Due to heavy clearing for cereal cropping throughout the Wimmera, it is likely that most of the species' habitat has been lost and the few remaining populations exist at or near the margins of cropping land. As such, the largest remaining population (occurring within the Little Desert Eastern Block) may not be fully representative of the 'preferred' habitat for the species. The Little Desert population is situated in

heathy mallee scrub and on slightly sandier soil than other occurrences. Associated species are *Eucalyptus phenax* Brooker & Slee, *Melaleuca uncinata* R.Br., *Daviesia pectinata* Lindl., *Acacia rigens* and *Eremophila gibbifolia* F.Muell. Another co-occurring wattle is *Acacia glandulicarpa* Reader, which is considered vulnerable (EPBC 1999). Glenlee Flora and Fauna Reserve may better represent the 'preferred' habitat of the species. Here it occurs in scrubby mallee woodland along with *Eucalyptus leucoxylon* F.Muell., *E. phenax* Brooker & Slee, *Allocasuarina luehmannii* (R.T.Baker) L.A.S.Johnson, *Acacia pycnantha* Benth., *A. acinacea* Lindl., *Dodonaea bursariifolia* F.Muell., *Ozothamnus retusus* Sond. & F.Muell. and *Lepidosperma viscidum* R.Br.

***Conservation status*:** This species has been conservatively assessed as endangered (EN) according to IUCN (2012) criteria. This classification is based on the species' extent of occurrence (EoO; *ca.* 1145 km^2), area of occupancy (AoO; *ca.* 5 ha) and number of locations (as defined by IUCN 2012 – 1 across the species EoO). Also contributing to the classification is the estimation of continuing decline in EoO, AoO and quality of habitat. It is conceivable that a very large proportion (90% or more) of the original extent of the species has been lost to agriculture, but there is insufficient evidence in the form of herbarium specimens to support this. If this extent of loss of occurrence were included in the assessment, a risk code of critically endangered (CR) *sensu* IUCN (2012), could be supported. Five of the seven known occurrences of the species are along degraded roadside vegetation remnants adjacent to crops, and without intervention, the future of these populations (some of only a single, old plant) is insecure. Approximately 50% of the largest population (Little Desert) was infertile when visited in December 2018. This may be a seasonal response after a very dry spring, however, it may indicate that the species does not produce abundant seed and that the soil seed bank, if insubstantial, may render the

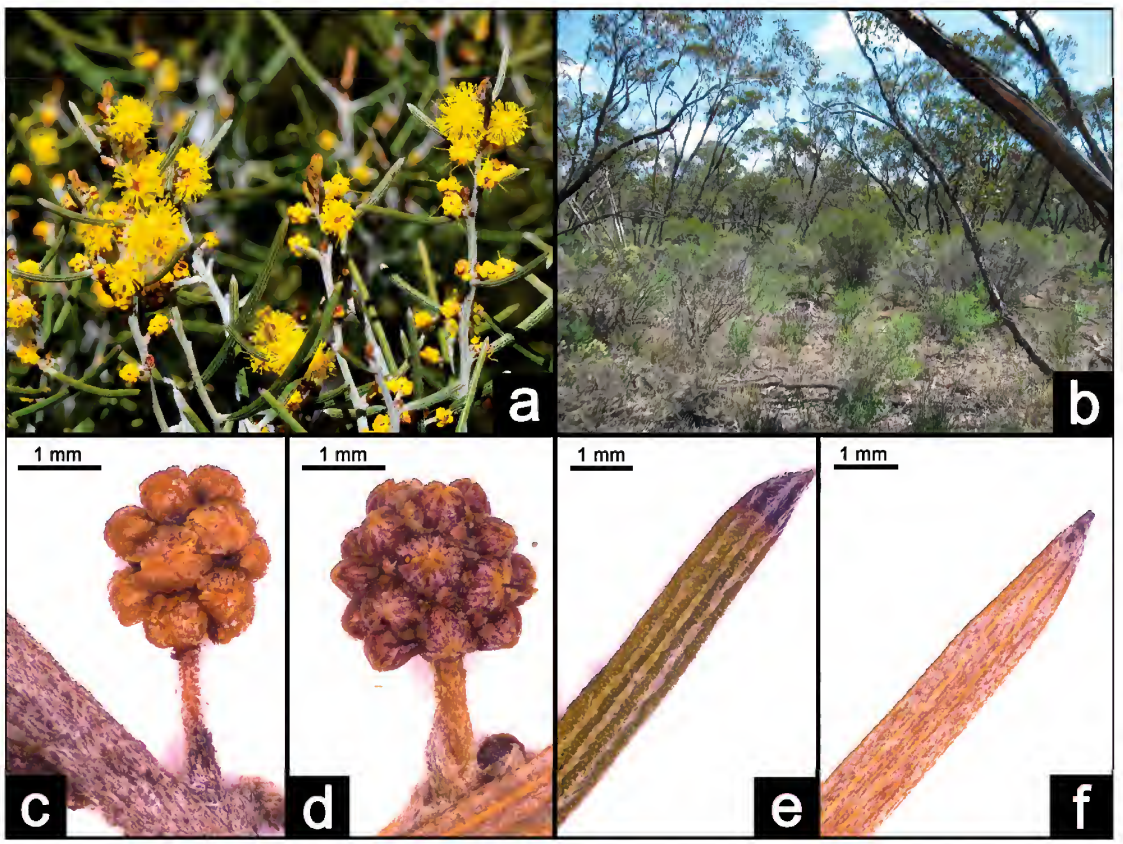

Figure 5. *Acacia cineramis* and *A. rigens*: a. Branchlets of *A. cineramis* with phyllodes and inflorescences (Photo: G. and M. Goods); b. *A. cineramis in situ*; c. Immature inflorescence of *A. cineramis*; d. Immature inflorescence of *A. rigens*; e. Phyllode of *A. cineramis*; f. Phyllode of *A. rigens*.

species vulnerable to repeated burning (a common management strategy in the Little Desert). Furthermore, some populations were observed to be heavily galled as a result of infection by a gall fungus, *Uromycladium* sp. This pathogen was observed affecting other *Acacia* species in the region and represents a threat to the species (Doungsa-ard *et al.* 2018), particularly when acting on smaller, more vulnerable populations in conjunction with other environmental stresses.

***Etymology*:** The species name is compounded and derived from the Latin words *cinereus* (ash-coloured) and *ramus* (branch) in allusion to the appearance of the branchlets of the species – one of the more obvious characters that distinguishes the plant from *Acacia rigens*.

***Notes*:** *Acacia cineramis* is distinguished from *Acacia rigens* by a number of distinctive features. In the field, *A. cineramis* is recognised by its slaty-green foliage and bronze-green new growth. The phyllodes of *A. rigens* are generally a brighter green but the new growth is of a similar colour to that of *A. cineramis* (Figure 6). While not retrieved as a primary character in the analysis, the orientation of the phyllodes on live plants may be a useful character: those of *A. cineramis* being widely spreading from the stems and those of *A. rigens* being very acutely inclined to stems in areas where the species co-occur. The branchlets of *A. cineramis* are very indistinctly ribbed and uniformly covered by a dense indumentum of closely appressed white hairs, whereas *A. rigens* displays strong yellow ribs that are more or less glabrous, with the branchlet indumentum occurring only between the ribs. As a consequence, the branchlets of *A. cineramis* are significantly whiter or greyer in colour than those of *A. rigens*. Perhaps the most reliable character in distinguishing between these species from dry specimens is the difference in phyllode nervature; *A. cineramis* is characterised by having eight prominent, raised nerves, often with a glabrous longitudinal groove between each nerve and subappressed hairs on the nerves (Figure 5e). The phyllodes of *A. rigens* possess significantly more nerves (from 14 to 29) which are less prominent and most commonly have subappressed hairs between the nerves (Figure 5f). Phyllodes of *A. cineramis* are generally shorter than those of *A. rigens* and reach a maximum length of 6.5 cm versus a maximum recorded length of 16 cm for the latter species. Differences in the inflorescence are also conspicuous, most notably in the number of flowers per capitulum (*A. cineramis* is 10–14-flowered, *A. rigens* is 20–33-flowered), and in the shape of the mature buds of individual flowers; *A. cineramis* possesses rounded, galeiform buds, whereas *A. rigens* displays buds that

Figure 6. Habit of *Acacia rigens* (left) and *A. cineramis* (right) in the field.

most commonly taper apically to a point (i.e. ogive-shaped). This latter feature results in the immature capitula of *A. rigens* generally appearing stellate or spiky, while those of *A. cineramis* appear more bulbous (Figure 5c & Figure 5d). Several other diagnostic features of *A. cineramis* are apparent, however their use may be limited in the field given their nature as microscopic characters. These include differences in the peduncle indumentum (which is dense and subappressed to spreading), branchlet hair length (hairs 0.1–0.4 mm long), and phyllode nerve equality (where in *A. cineramis* all visible nerves are equal).

Acknowledgements

We express our thanks to Graham and Maree Goods for their rediscovery of *A. cineramis* after over 30 years (thereby allowing us to search other likely habitat), and their hospitality and assistance in the field. Gratitude is also extended to Andre Messina for assistance with data analysis and to Daniel Ohlsen for assistance generating IUCN threat assessments. We thank Martin O'Leary for his help and knowledge regarding various South Australian specimens. Bruce Maslin's contribution has been significant through his separation of some specimens of *Acacia cineramis* from *Acacia rigens* at MEL in the past and flagging this as an unresolved taxonomic issue with MEL botanists, consequently leading to this study. We also thank two anonymous reviewers for their feedback and suggestions on this manuscript. This project was undertaken as part of the Jim Willis Summer Studentship program (RBGV), an initiative instigated through the philanthropy of Roger Riordan AO and the Cybec Foundation. We were greatly saddened to learn of Roger's death on January 2, 2019, during the course of this study.

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Muelleria

38: 101–109

Published online in advance of the print edition, 17 February 2020

ROYAL BOTANIC GARDENS VICTORIA

Lectotypification of *Atriplex stipitata* Benth. (Chenopodiaceae) and recognition of a new subspecies

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Introduction

Atriplex stipitata Benth. is a widespread member of *Atriplex* Section Dialysex Moq. It occurs in all mainland states. Plants are generally low, shrubby, predominantly dioecious perennials. The species has very distinctive reniform fruiting bracteoles with a prominent stipe, leading to its common name of Kidney Saltbush. It is readily identified when fruit are available, and the reliance on fruit characters alone appears to have led to a simplistic appreciation of the species. Observations of specimens identified as *Atriplex stipitata* in the field and herbarium suggest the existence of two distinct taxa. As represented by the type, *A. stipitata* is a relatively sturdy, spreading-erect perennial shrub with relatively broad leaves and stems. The other putative taxon is a gracile, erect and probably rather short-lived shrub typically with narrow leaves and fine branches. Closer examination shows that the gracile form is monoecious, whereas the type form is dioecious or, in very few cases, monoecious but then with male and female inflorescences distinctly separated on plants. The gracile form has inflorescences with female flowers mixed with males in glomerules along the axes of the inflorescences or, sometimes, 1–few in leaf axils below the inflorescence. The gracile form is accordingly described here as a new subspecies.

Bentham (1870) cited a number of specimens in the protologue for *Atriplex stipitata* but neither he, nor Aellen (1937, 1938) or Wilson (1984) nominated an individual type for the species. As far as can be ascertained

Abstract

A new subspecies of *Atriplex stipitata* Benth is described and its distribution and habitat provided. At the broad scale it is largely co-extensive with the type subspecies, but there is currently no evidence of the two being sympatric. The new subspecies is apparently very rare in the Western Australia. A lectotype is chosen for *A. stipitata*.

Keywords: Kidney saltbush; *Atriplex miscella*; monoecious; revegetation.

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

from images available on JSTOR (2019) and those at MEL, each of the collections appear to represent the typical subspecies. In order to avoid any chance of ambiguity about the application of the name, the opportunity is taken here to lectotypify *A. stipitata*.

Results and Discussion

Taxonomy

***Atriplex stipitata* Benth., *Fl. Austral.* 5: 168 (1870).**

***Type*: AUSTRALIA.** "**N.S. Wales.** Desert of the Darling, Victorian Expedition, Mrs Ford; also in Leichhardt's collection. **Victoria.** In the N.W. portion of the colony, L. Morton (the specimen not in fruit and therefore doubtful). **S. Australia.** Murray scrub, Behr., F. Mueller; Gawler's range, Sullivan; towards Spencer's Gulf, Warburton."

LECTOTYPE (here designated): East Australia [New South Wales], F.W.L. Leichhardt *s.n.* (MEL 0607137 !); REMAINING SYNTYPES: New South Wales: Durroodoo, Vict. Expl. Exped. [Victorian Exploring Expedition], *H. Beckler s.n.*, 27 Dec. 1860 (K 000898568, image seen); Vict. Exped [Victorian Exploring Expedition], *H. Beckler s.n.*, 13.ii.1861 (MEL 607144 !); Darling Desert, F. Mueller *s.n.* 1869 (K 000898569, image seen); Darling Desert, *H. Beckler s.n.* (MEL 607138 !, 607143 !); Wentworth, Darling River, *Mrs Forde s.n.* (MEL 607139 !). South Austalia: Gawler Range, *Dr Sullivan s.n.* (MEL 606994 !); Murray Scrub, *H.H.Behr*, March 1849 (MEL 607142!); Murray Desert in S. Austr., *F. Mueller s.n.*, 1848 (MEL 607145 !). Victoria: N.W. Victoria, *L. Morton s.n.* (MEL 607140 !).

Non *Atriplex stipitata* Westerl., *Linnaea* 40; 165 (1876) nom. illeg.

Typification: Type material at K, from which a lectotype might be expected to be chosen, consists of 3 collections mounted on the one sheet (Darling Desert; Duroodoo, Victorian Exploring Expedition; Murray Scrub). All are dated 1869, which is presumably the date of receipt or examination of the material by Bentham, and the only apparent collector's name is F. Mueller. Mueller certainly did not collect either the Darling Desert or the Duroodoo specimens (both Beckler collections), and the 'Murray Scrub' collection could be either Mueller's or Behr's. Of these three specimens, only one, 'Murray Scrub', includes the characteristic fruits of *A. stipitata* which would desirably be a part of a type. Two sheets labelled 'Murray Scrub', one collected each by Mueller and Behr, are at MEL. The Behr sheet includes a few ripe fruits in a packet, but most of the mounted twigs are of male inflorescences. It is almost certain that this sheet represents gatherings from more than one plant. The Warburton 'toward Spencers Gulf' sheet (MEL 607136) is sterile and has been redetermined as *A. vesicaria* Heward ex Benth. (G.A. Parr-Smith *in sched.*). The Morton collection 'N.W. Victoria', as noted by Bentham in the protologue, is sterile but vegetatively resembles *A. stipitata* subsp. *stipitata*. It is tentatively included amongst the syntypes. All other syntypes at MEL (marked to indicate that Bentham had seen them), with the exception of the Leichhardt collection are, surprisingly, of male plants, or of mixed collections containing branchlets from male and female plants. The Leichhardt sheet (MEL 0607137) is unambiguously from a single branchlet bearing mature and immature fruits. As there seems to be no uncertainty about the provenance of this specimen and it displays well the characteristic fruits of *A. stipitata*, it is here chosen as the lectotype (Figure 1).

Atriplex stipitata Westerl. is a later homonym (Westerlund 1876), apparently representing a hybrid between the northern European *A. longipes* Drejer. subsp. *longipes* and *A. prostrata* DC. subsp. *calotheca* (Raf.) M.A.Gust.(Rafin.) M. Gust. (fide M. Gustaffston 1990, *in sched*. LUND 1224615).

Atriplex stipitata subsp. *miscella* N.G.Walsh & I.R.K.Sluiter subsp. nov.

***Type*: AUSTRALIA.** Murray Sunset National Park, Henschke Tk, *ca.* 100 m E from its junction with Midnight Tank Tk., 24.xi.2011, *N.G. Walsh 7483, J.L. Birch, C.L. Gallagher, S. Stewart* (holotype: MEL 2357412; isotypes: AD, NSW).

Differs from the type subspecies in having generally narrower leaves, finer stems, an erect, upright habit and in having female flowers mixed within the males, or sometimes the females solitary, or rarely a few in leaf axils below the main inflorescence, not in unisexual terminal spicate inflorescences as in the type subspecies.

Sparse, twiggy, more or less erect shrub to *ca.* 60(–100) cm high. Stems rather fine, those of the inflorescence axis *ca.* 3 nodes from tip usually <0.5 mm diam. Leaves narrowly oblong to (usually narrowly) elliptic, (4–)7–20(–27) mm long, 1.5–4.5(–10) mm wide, length-width ratio (2–)3.5–4.5(–5.5). Inflorescences simple or sparingly branched

Figure 1. *Atriplex stipitata* lectotype (MEL 607137).

Pocket Empty
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2357412
Atriplex stipitata Benth.
Det.: Walsh, N.G., 24 Nov. 2011
Coll.: Walsh, N.G. 7483 Date: 24 Nov. 2011
Addit. Coll.: Birch, J.L.; Gallagher, C.; Stewart, S.
Collecting trip: National Herbarium of Victoria Field Trip 2011 (22–25 Nov. 2011).
Australia: Victoria
Loc.: Murray Sunset National Park, Henschke Tk, c. 100 m E from its junction with Midnight Tank Tk.
34° 34' 27" S 141° 56' 41" E. Alt.: 40 m.
Habitat: Treeless subsaline depression surrounded by chenopod-mallee woodland.
Associated taxa: Atriplex acutibractea, A. eardleyae, Angianthus tomentosus, Osteocarpum acropteron, Sclarochlamys brachyptera
Descriptive notes: Delicate twiggy subshrub, c. 50 cm high.
Collecting notes: Locally common.
Dupl.: AD, NSW
Main collection: D. Dicots – 070. Chenopodiaceae (5. Australasia)
Printed from MELISR, 21 Mar. 2012
NATIONAL HERBARIUM OF VICTORIA (MEL)
A. stipitata Benth. subsp. miscella N.G.Walsh & Sluiter
Determinavit: N.G.Walsh 21·vi·2019
HOLOTYPE
cm
copyright reserved
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA

Figure 2. *Atriplex stipitata* subsp. *miscella* holotype (MEL 2357412).

spikes; flowers clustered in more or less spherical glomerules to *ca.* 2 mm diam., each usually comprising mostly male and 1-several female flowers, occasionally female flowers 1–few in leaf axils below the main inflorescence. Male perianth *ca.* 1 mm long, dehisced anthers mostly *ca.* 3 mm wide. Fruiting bracteoles stipitate, the stipe-like portion *ca.* 4–9 mm long, the reniform bracteoles (4–)5–6(–7) mm long, (5–)7–9(–11) mm wide, apex usually somewhat pointed, at least when immature, margins entire (Figures 2, 3).

Selected specimens (from *ca.* 80 examined): WESTERN AUSTRALIA. Adjacent to Wattoning Reserve, *B.J. Lepschi 3373 & T. Lally*, 8.ii.1997 (AD, CANB, PERTH). **NORTHERN TERRITORY.** Simpsons Gap N.P., *P.K. Latz 8546*, 24.xi.1980; 10 km N of Kulgera, *C. Lendon 37*, 10.iv.1973 (AD, NT). **SOUTH AUSTRALIA.** 10 km E of Mintabie, *P.K. Latz 25209*, 10.iii.2010 (AD, NT); 27 km W of Balcoonoona, *S.W.L. Jacobs 3631*, 19.v.1979 (AD, NSW); Danggali Conservation Park, *K.P. Nicolson & D.E. Peacock BS24-52941*, 12.vii.1991 (AD). **QUEENSLAND.** Wittenburra Stn, 36 miles [*ca.* 58 km] S of Eulo, *L.S. Smith 66*, 7.i.1937 (BRI); The Bluff, E of Yowah, *J.L. Silcock 788*, 18.ii.2011 (BRI). **NEW SOUTH WALES.** Caradoc Stn 25 km N of White Cliffs, *J. Piggin s.n.* ix.1993 (CANB); Byrock Rd, Bourke, *E.J. McBarron 18508*, 15.xi.1969 (NSW); Boppy Mountain, 25 miles [40 km] E of Cobar on Barrier Highway, *C.W.E. Moore 5663*, 19.vi.1970 (CANB, NSW); *ca.* 15 miles [24 km] W of Louth, *C.W.E. Moore 5646*, 11. Xi.1969 (CANB, NSW). **VICTORIA.** Near Lindsay Point (industrial area), *V. Stajsic 7091 & J.A. Jeanes*, 20.xi.2013 (MEL); Hattah Kulkyne National Park, Mournpall Block, *I.R.K. Sluiter 8*, 2.xii.1991 (MEL).

Distribution: From more than 500 herbarium specimens examined, some observations of the relative abundance of the two subspecies may be made. In Western Australia, subsp. *miscella* is apparently rare and currently known only from a single collection *ca.* 80 km N of Merredin (Lepschi 3373) while subsp. *stipitata* is moderately common in inland areas of the south-west. In southern parts of the Northern Territory, both subspecies are present, but based on specimens at NT, subsp. *miscella* appears to be the commoner (P. Jobson pers. comm.). In South Australia, subsp. *miscella* is locally common in the North-West, the Flinders Ranges, and the Murray Mallee regions, while subsp. *stipitata* occurs in all regions except the South-East and Kangaroo Island. The species is relatively rare in Queensland (only 8 specimens represented in Australian herbaria, all from the Warrego Pastoral District) where both subspecies occur, with subsp. *miscella* apparently more common.

Figure 3. *Atriplex stipitata* subsp. *miscella* habit, Yarrara Flora and Fauna Reserve, NW Victoria (*N.G.Walsh 7423*, 22.xi.2011, MEL 2357284) (image N.G. Walsh).

In the species' range through western New South Wales, the two subspecies are similarly dispersed but subsp. *miscella* is more abundantly represented in herbaria. In Victoria, subsp. *miscella* is restricted to the far north-west while subsp. *stipitata* occurs there and has a remarkable disjunct occurrence near Bacchus Marsh (*ca.* 50 km NW of Melbourne) (Figure 4).

Habitat: Generally found on soils with topsoil textures of sandy clay loam, light sandy clay loam or sandy loam, occasionally including some limestone nodules or other stones or rock. Collectors' notes indicate that occupied landforms include 'swale between dunes', 'creek bank', 'stony flats and outwash plains', 'on dry stony, pebbly ridges', 'stony slope', 'flat plain'. It is often recorded as a member of open woodland communities with trees including *Acacia aneura* Benth., *A. excelsa* Benth., *A. loderi* Maiden, *Alectryon oleifolius* (Desf.) S.T.Reynolds, *Callitris* sp., *Eucalyptus intertexta* R.T.Baker, *E. populnea* F.Muell., *Flindersia maculosa* (Lindl.) Benth. These associations do not indicate a vast ecological difference between the two subspecies, but collectors' notes on specimens of subsp. *stipitata* suggest perhaps that it has a stronger affinity with saline soils (tending to clay loam), less of a tendency to be associated with woodlands and more often a component of mixed chenopod shrublands.

Etymology: The epithet, *miscella*, is from Latin, meaning mixed, a reference to the mixed male and female flowers in glomerules of the inflorescence.

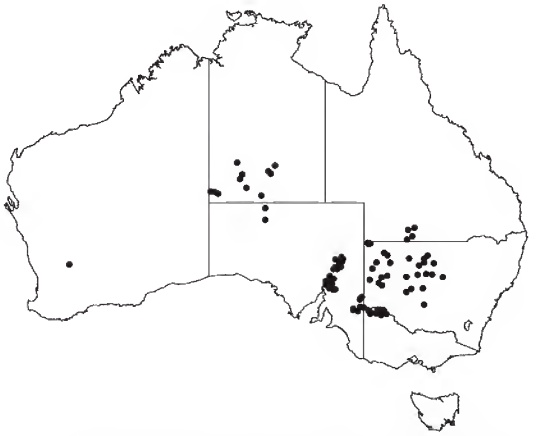

Figure 4. *Atriplex stipitata* subsp. *miscella* distribution (from herbarium specimens at AD, CANB, MEL, NSW, SA, PERTH).

Notes: In general, the habit of subsp. *miscella* is more upright, twiggier with finer stems and sparser-leaved than that of subsp. *stipitata* (Figure 5). Notes on specimens indicate that subsp. *stipitata* is not infrequently 1 m high or more and often wider than high whereas subsp. *miscella* is generally described on collecting notes as growing to *ca.* 60 cm high and not wider than this. The leaves are typically narrower than those of subsp. *stipitata*

Figure 5. *Atriplex stipitata* subsp. *stipitata* habit, *ca.* 33 km SW of Pooncarie, SW New South Wales (*I.R.K. Sluiter s.n.*, 17.ix.2015, MEL 2407046). The quadrat frame is 1 x 1 m (image I.R.K. Sluiter).

with length-width ratio (2–)3.5–4.5(–5.5) while those of subsp. *stipitata* have length-width ratio of 1.5–2.5(–3) and are up to 30 mm long and 14 mm wide.

The inflorescences of subsp. *miscella* are simple or may be few-branched with more-or-less spherical glomerules about 2 mm diam. The male inflorescences of subsp. *stipitata* are often many-branched with glomerules about 3 mm diam. and those of short lateral branches very crowded such that they appear to be cylindrical spikes to *ca.* 1 cm long (Figure 6). In both subspecies, female flowers may be in axils of leaves subtending the main part of the inflorescence, or in subsp. *stipitata*, in female-only glomerules in few-branched inflorescences (Figure 7). In very few instances (<1% of all specimens examined) subsp. *stipitata* may have a very few female flowers in otherwise male inflorescences. Limited observation indicates the anthers of subsp. *miscella* are smaller than those of subsp. *stipitata* (0.3 mm wide when dehisced vs 0.5 mm wide respectively). The fruiting bracteoles of both subspecies are similar, but those of subsp. *stipitata* may be slightly larger and up to 12 mm wide. The apices of the fruiting bracteoles of subsp. *miscella* are often obtusely angled rather than the more typically rounded shape of subsp. *stipitata*, a character which is particularly apparent when the fruits are immature with the margins entire, while those of subsp. *stipitata* are often erose-crenate. The seeds of both subspecies appear identical.

It could be interpreted that the significant differences between subsp. *stipitata* and subsp. *miscella* in habit, floral sex distribution and, to some extent habitat, warrant the recognition of subsp. *miscella* at species rank. This option has not been taken here mainly due to the historical primacy in *Atriplex* taxonomy, at least in Australia, of the form of the fruiting bracteoles in establishing species boundaries. To date, no distinguishing features of the fruiting bracteoles have been detected that allow reliable assignment to either taxon, although a slight difference in marginal features (as noted above) can be suggestive of one or the other. The dioecy/monoecy distinction is persuasive, but in both subspecies there are a few specimens that display a slight deviation from either state, so this cannot be used as an absolute trait to separate the two taxa. Further studies (e.g. cytological, molecular) may indicate elevation to species rank is warranted, but on the basis of current knowledge, subspecies rank is considered to be appropriate for the new taxon.

The distinctness of the new subspecies was first suspected by one of us (IRKS) when observing a post-mining revegetation plot in far south-west New South Wales. Previous surveys had shown that *Atriplex stipitata* subsp. *miscella* was the local subspecies, but subsp. *stipitata* had been used in the revegetation mix, on the basis of the *species* being local to the area, but from seed collected some 200 km to the south-west, near Blanchetown (SA) where subsp. *stipitata* was fruiting abundantly (subsp. *miscella* rarely produces copious seed). While there has been a wide acceptance of the need to widen genetic diversity in revegetation or translocation endeavours (e.g. following Broadhurst *et al.* 2008), in this case the opportunity to take advantage of a mast fruiting event had resulted in what we believe to be an inappropriate selection for the recipient area. It is recommended that some caution be exercised against roaming too widely to source seed in revegetation work to avoid collection of cryptic, perhaps unrevealed taxa.

Acknowledgements

We are grateful to directors and staff of AD, CANB, NSW and PERTH for access to specimens and preparing loans of specimens, to Kelly Shepherd, Peter Jobson, Jen Silcock and Dave Albrecht for examining specimens on our behalf from PERTH, NT, BRI and CANB respectively, to Alison Vaughan who prepared the distribution map from herbarium records, to Angharad Johnson who photographed the type specimens and to three referees for their helpful comments on the manuscript.

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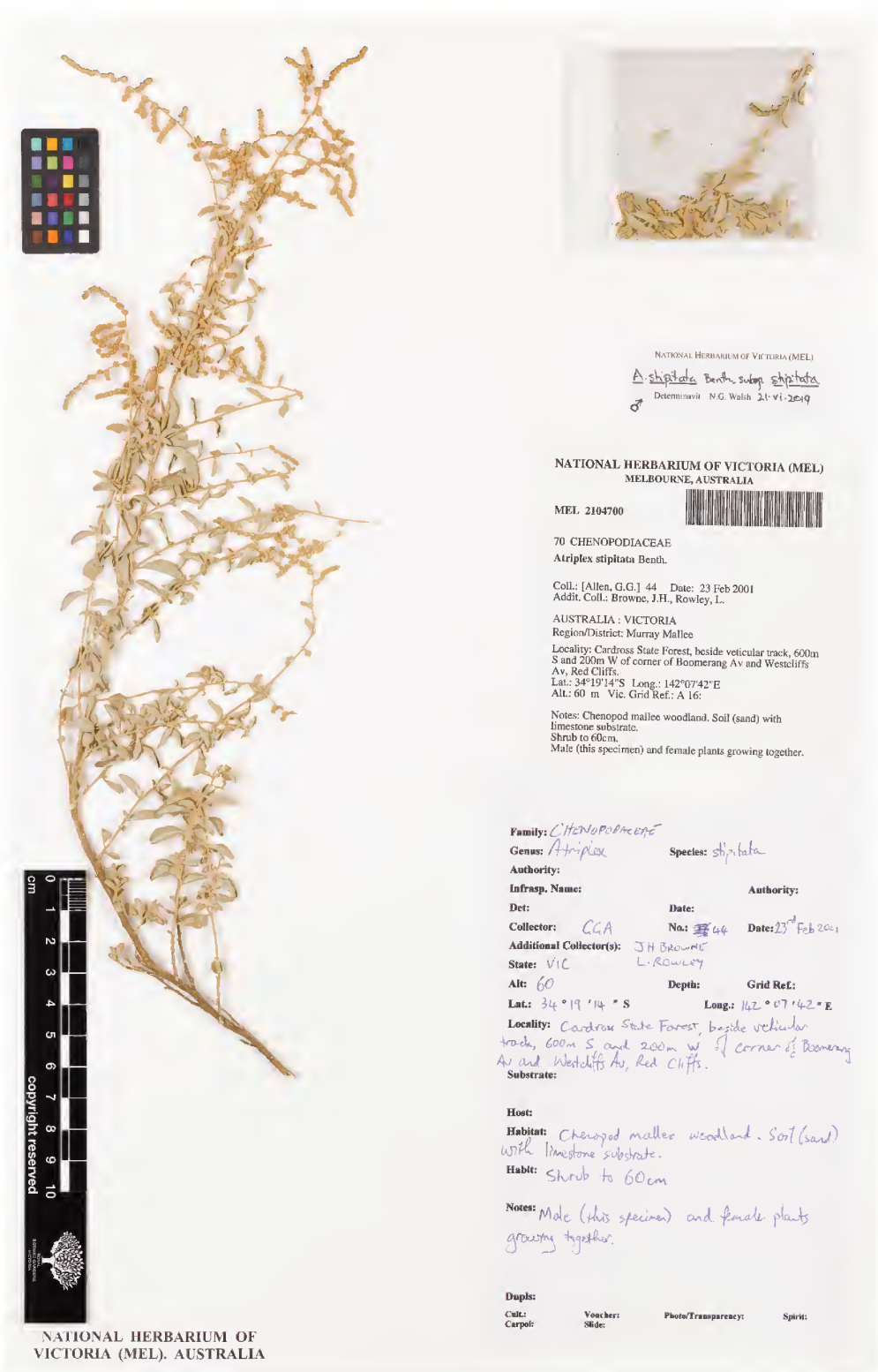
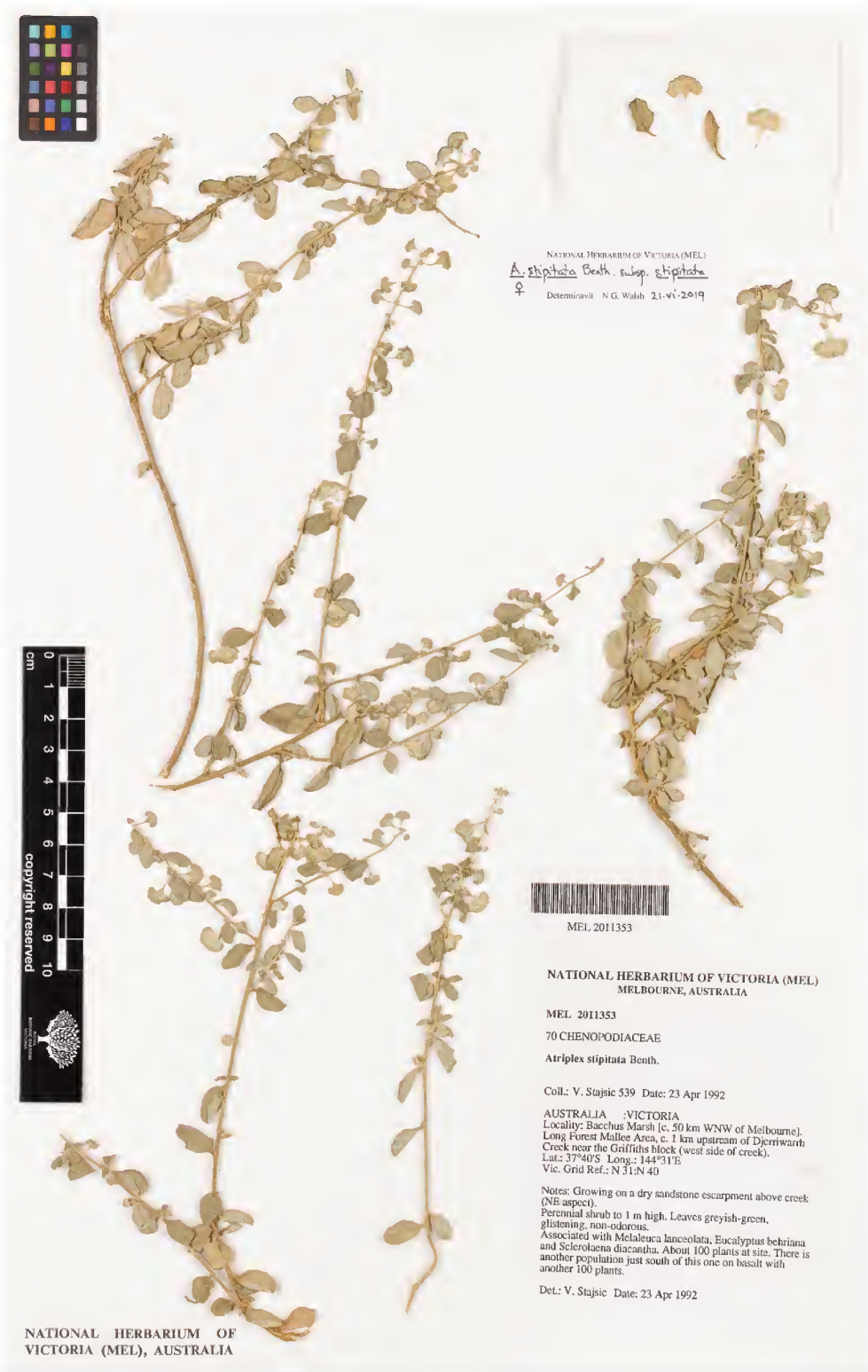

NATIONAL HERBARIUM OF VICTORIA (MEL)
A. stipitata Benth. subsp. stipitata
Determinavit N.G. Walsh 21-vi-2019
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2104700
70 CHENOPODIACEAE
Atriplex stipitata Benth.
Coll.: [Allen, G.G.] 44 Date: 23 Feb 2001
Addit. Coll.: Browne, J.H., Rowley, L.
AUSTRALIA : VICTORIA
Region/District: Murray Mallee
Locality: Cardross State Forest, beside veticular track, 600m S and 200m W of corner of Boomerang Av and Westcliffs Av, Red Cliffs.
Lat.: 34°19'14"S Long.: 142°07'42"E
Alt.: 60 m Vic. Grid Ref.: A 16:
Notes: Chenopod mallee woodland. Soil (sand) with limestone substrate.
Shrub to 60cm.
Male (this specimen) and female plants growing together.
Family: CHENOPODIACEAE
Genus: Atriplex
Species: stipitata
Authority:
Infrasp. Name:
Authority:
Det:
Date:
Collector: GGA
No.: 44
Date: 23rd Feb 2001
Additional Collector(s): JH BROWNE L. ROWLEY
State: VIC
Alt: 60
Depth:
Grid Ref.:
Lat.: 34 ° 19 ' 14 " S
Long.: 142 ° 07 ' 42 " E
Locality: Cardross State Forest, beside veticular track, 600m S and 200m W of corner of Boomerang Av and Westcliffs Av, Red Cliffs.
Substrate:
Host:
Habitat: Chenopod mallee woodland. Soil (sand) with limestone substrate.
Habit: Shrub to 60cm
Notes: Male (this specimen) and female plants growing together.
Dupls:
Coll.:
Carpol:
Voucher:
Slide:
Photo/Transparency:
Spirit:
cm
0 1 2 3 4 5 6 7 8 9 10
copyright reserved
NATIONAL HERBARIUM OF VICTORIA (MEL). AUSTRALIA

Figure 6. *Atriplex stipitata* subsp. *stipitata* specimen, male plant (MEL 2104700).


NATIONAL HERBARIUM OF VICTORIA (MEL)
A. stipitata Benth. subsp. stipitata
♀
Determinavit N G. Walsh 21-VI-2019
MEL 2011353
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2011353
70 CHENOPODIACEAE
Atriplex stipitata Benth.
Coll.: V. Stajsic 539 Date: 23 Apr 1992
AUSTRALIA :VICTORIA
Locality: Bacchus Marsh [c. 50 km WNW of Melbourne].
Long Forest Mallee Area, c. 1 km upstream of Djerriwarrh
Creek near the Griffiths block (west side of creek).
Lat.: 37°40'S Long.: 144°31'E
Vic. Grid Ref.: N 31:N 40
Notes: Growing on a dry sandstone escarpment above creek
(NE aspect).
Perennial shrub to 1 m high. Leaves greyish-green,
glistening, non-odorous.
Associated with Melaleuca lanceolata, Eucalyptus behriana
and Sclerolaena diacantha. About 100 plants at site. There is
another population just south of this one on basalt with
another 100 plants.
Det.: V. Stajsic Date: 23 Apr 1992
cm
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VICTORIA (MEL), AUSTRALIA

Figure 7. *Atriplex stipitata* subsp. *stipitata* specimen, female plant (MEL 2011353).

Muelleria

38: 111–123

Published online in advance of the print edition, 17 February 2020

ROYAL BOTANIC GARDENS VICTORIA

Notes on *Pimelea curviflora* and *P. micrantha* (Thymelaeaceae, Sect. Epallage) and recognition of two new subspecies of *P. curviflora*

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Abstract

The complex comprising *Pimelea curviflora* R.Br. and *P. micrantha* F.Muell. ex Meisn. is reassessed and two new south-eastern Australian subspecies of *P. curviflora*, namely subsp. *fusiformis* N.G.Walsh & E.M.Schulz and subsp. *planiticola* N.G.Walsh & E.M.Schulz, are described, illustrated and mapped. Seeds have been identified as particularly useful in discriminating between members of the group and are illustrated for this purpose. Taxa previously treated as varieties of *P. curviflora* are elevated to subspecies, lectotypes are nominated as required, and notes on typification in the group are provided.

Introduction

The circumscription of *Pimelea curviflora* R.Br. is problematic. In the most recent comprehensive account of the genus, Rye (1990) recognised six varieties of *P. curviflora* and commented, 'A highly variable species in need of further study. The status of the 6 varieties recognised here needs to be re-examined, and at least 1 new variant needs to be named'. Under the account of *P. curviflora* var. *subglabrata* Threlfall, Rye noted 'an unnamed variant from S.A. and Vic. keys to var. *subglabrata*'. The significant feature of this variant, linking it to var. *subglabrata*, is its short sepal length of 0.6–1 mm, compared to the other five named varieties of *P. curviflora* with sepals 1.2–3 mm long.

Two of the named varieties of *P. curviflora*, var. *gracilis* (R.Br.) Threlfall and var. *sericea* Benth., occur in Victoria along with the unnamed *subglabrata*-like variant, as well as the apparently closely related *P. micrantha* F.Muell. ex Meisn. with sepals *ca.* 0.5 mm long. In a treatment of the genus in *Flora of Victoria*, Entwisle (1996) recognised both *P. curviflora* and *P. micrantha*, but did not formally distinguish the varieties *gracilis* and *sericea*, although their different morphologies and geographic ranges were discussed. The unnamed variant was discussed too, as was a dubious record of

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

P. curviflora var. *divergens* Threlfall, also mentioned by Rye (1990).

This unsatisfactory situation has led to considerable confusion in the application of names in Victoria. Specimens of *P. curviflora* and *P. micrantha* were reassessed at MEL in an attempt to clarify taxon boundaries and produce a workable treatment. No genuine specimens of *P. curviflora* var. *subglabrata* were available at MEL, but specimens of this and other members of the group were borrowed from NSW and included in the study. Other members of the complex not known to occur in Victoria (i.e. varieties *curviflora*, *divergens* Threlfall and *acuta* Threlfall) were examined to confirm their distinctness and to preclude the possibility of any of these names being applicable to unplaced Victorian samples. Inspection of representatives of these varieties suggests that they are reasonably well circumscribed both morphologically and geographically.

Those characters used in Rye's 1990 treatment were closely examined, as was an earlier treatment of the genus in Australia by Threlfall (1983). While both treatments employed seed characters to some extent, these were found to be particularly useful and so aspects of seed morphology not discussed in either of these studies were considered.

Two distinct unnamed entities were recognised amongst specimens of *P. curviflora* and *P. micrantha* at MEL and those borrowed from NSW. One shared some features with *P. curviflora* var. *subglabrata*, i.e. short sepals, leaves mostly glabrous or nearly so on the adaxial surface and straight, rather than curved fruit (a characteristic of var. *curviflora*), but the seed shape and growth habit were distinctive for both these unnamed entities. The second unnamed entity appeared somewhat intermediate vegetatively between *P. curviflora* var. *gracilis* and *P. micrantha*, but differed from both in the seed, which had a slight constriction toward the apex (reminiscent of the 'skittle-shaped' or 'peanut-shaped' seed of *P. micrantha*), but was distinctive in its acute, shortly uncinate apex. From *P. curviflora* var. *gracilis* it differed further in having distinctly shorter sepals. While some specimens of the latter type had been determined as 'var. aff. *subglabrata*' at MEL, most specimens of the latter were found within folders of *P. micrantha* or *P. sericea* var. *gracilis*.

Rank is problematic in the *P. curviflora-micrantha* complex. For example, Threlfall (1983) recognised *P. micrantha*, *P. curviflora* var. *curviflora* and *P. curviflora* var. *gracilis* (as recognised by Rye) all as subspecies of *P. curviflora*, while the other taxa were treated as varieties of *P. curviflora* subsp. *gracilis* (R.Br.) Threlfall. Rye (1990) treated *P. micrantha* as a distinct species and others at a single infraspecific (varietal) rank while noting var. *acuta* to be 'the most distinctive of the varieties recognised and [that it] possibly should be regarded as a subspecies or even as a separate species'. A case exists to return *P. micrantha* to subspecific rank under *P. curviflora* (the earlier name) to underline their morphological proximity, but we consider the combined features of the corolla (very short 'style portion' *sensu* Rye (1988), and fruit to warrant maintenance at species rank. At least some of the members of *P. curviflora* could probably be recognised as good species (as suggested by Rye for var. *acuta*) but the intent of the current study is to clarify the taxonomy of the group in Victoria. We consider that, in addition to morphological features, there are geographic and ecological signals that help to separate the taxa, criteria that support recognition at subspecific rank at least. Looking beyond the Victorian taxa, other members of the *P. curviflora-P. gracilis* complex are similarly well defined morphologically and geographically, so, to maintain taxonomic consistency in the group, the other varieties are here elevated to subspecies rank. A more detailed study of the complex, perhaps incorporating molecular data, is warranted to establish a reliable hierarchy of its components.

Materials and methods

Descriptions are based on field-collected plants and herbarium specimens at MEL and limited numbers of specimens at AD and NSW and type specimens that were accessed online through Global Plants (http://plants.jstor.org/, accessed 31 May 2019) and by correspondence with herbaria not represented on the Global Plants websites. Floral measurements were made primarily from herbarium specimens. Flowers of *Pimelea* are considered to be derived from fused elements of the calyx and corolla and the perianth is described as being composed of the ovary portion (from the base to the point that the floral tube abscises during fruit development), and the 'style portion' (that part above the abscission point) following Rye (1988).

Irrespective of the true origin of the floral parts, the lobes of the perianth are here referred to as sepals. Lengths of elements of the perianth are measured at the time of abscission of the style portion. The fruit, at time of shedding, includes the remnant of the ovary portion closely enclosing the achene, which consists of a thin membranous epicarp loosely overlaying the seed itself. The patterning of the seed coat is apparent through the fine, closely-enveloping mesocarp but is clearer if a portion of this layer is carefully scraped away. The photographs (Figs 1, 2), taken on a Leica M205C stereomicroscope processed via Leica application suite Version 4.9, are of seeds from which the mesocarp has been removed.

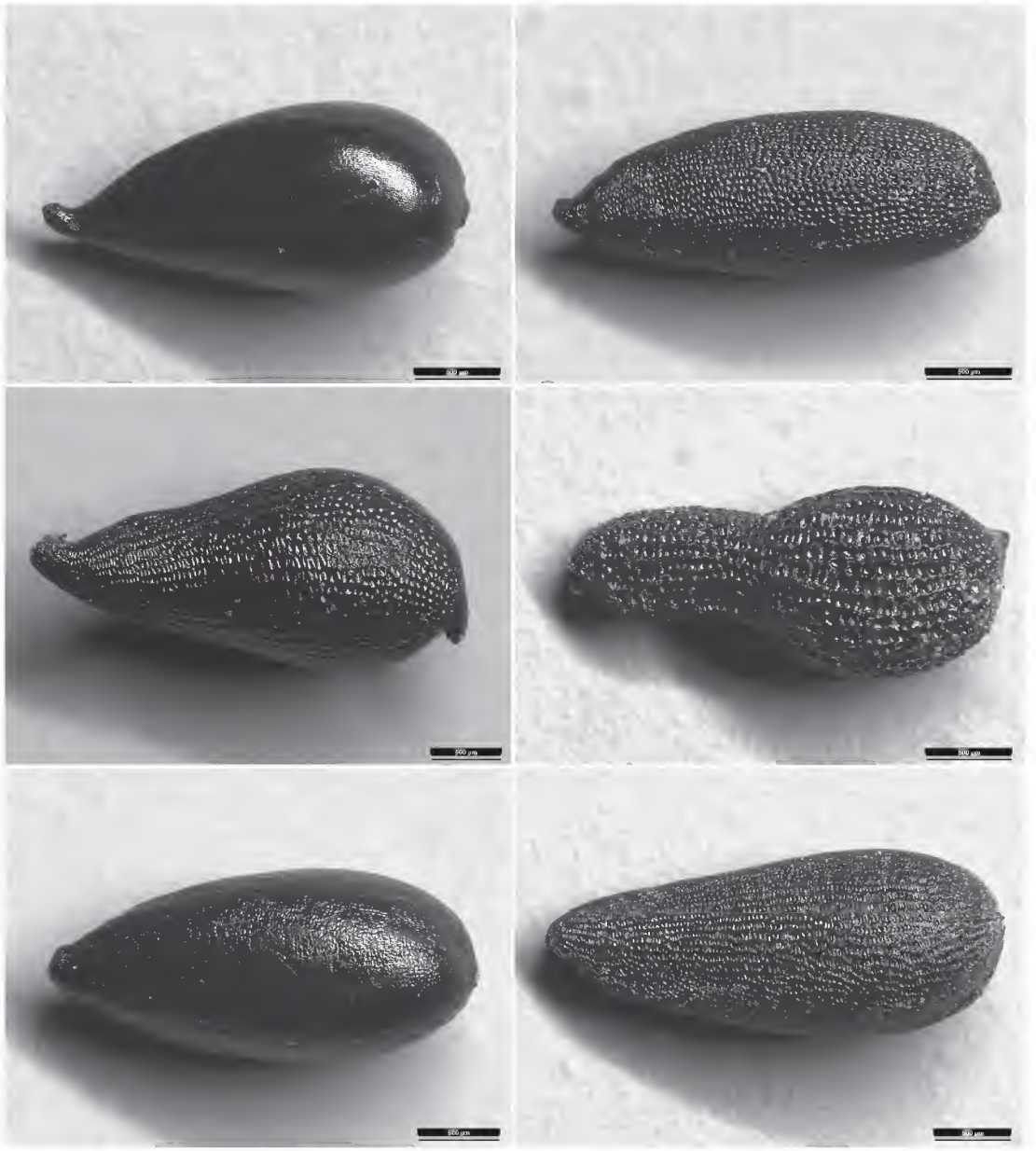

Figure 1. *Pimelea* seed. a. *P. curviflora* subsp. *subglabrata* (NSW 273649); b. *P. curviflora* subsp. *fusiformis* (MEL1559898); c. *P. curviflora* subsp. *planiticola* (MEL 2134990); d. *P. micrantha* (MEL50719); e. *P. curviflora* subsp. *sericea* (MEL 50768); f. *P. curviflora* subsp. *gracilis* (MEL 222164). Scale bars 0.5 mm.

NATIONAL HERBARIUM OF VICTORIA (MEL) HOLOTYPE
P. curviflora subsp. fusiformis N.G.Walsh & E.M.Schulz
Determinavit: N.G.Walsh 3-vi-2019
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2418230
Pimelea curviflora var. nov.
Det.: Walsh, N.G., 9 Nov. 2017
Coll.: Walsh, N.G. 8753 Date: 9 Nov. 2017
Addit. Coll.: Messina, A.
Australia: Victoria
Loc.: Bunyip State Park, Towt Rd (=Back Creek Rd), just S of its junction with Watsons Tk, 9.8 km direct NNW from Tonimbuk Hall.
37° 57' 54" S 145° 52' 08" E. Alt.: 145 m.
Associated taxa: Leptospermum myrsinoides, Lomandra filiformia, Pimelea phylicoides, Dampiera stricta, Gahnia radula, Bauera rubioidea, Xanthosia tridentata, Laxmania orientalis, Eucalyptus cephalocarpa, E. dives (local form).
Descriptive notes: Spreading to erect few-branched shrublets no taller than 15 cm high. Corolla cream in tubular part, merging to red lobes.
Natural occurrence: Native
Collecting notes: Locally rare. Population extends south from Watsons Tk for c. 200 m and evident only on slashed verge on western side of road.
Dupl.: CANB
192. Thymelaeaceae – D. Dicots – Main collection (5. Australasia)
Printed from MELISR, 03 Jul. 2019
TYPE
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA
copyright reserved
cm 0 1 2 3 4 5 6 7 8 9 10

Figure 2. Holotype of *Pimelea curviflora* subsp. *fusiformis* (MEL2418230).

Taxonomy

Pimelea curviflora subsp. *fusiformis* N.G.Walsh & E.M.Schulz subsp. nov.

***Type*: AUSTRALIA.** Victoria. Bunyip State Park, Towt Rd (=Back Creek Rd), just S of its junction with Watsons Track, 9.8 km direct NNW from Tonimbuk Hall, *N.G. Walsh 8753 & A. Messina*, 9.xi.2017 (holo: MEL 2418230 !; iso: CANB !).

Amongst the other subspecies of *Pimelea curviflora*, subsp. *fusiformis* most closely resembles subsp. *subglabrata*, but is generally of a more spreading habit and has narrower, more or less fusiform (rather than ovoid) seeds that are generally distinctly textured (rather than smooth). It resembles subsp. *curviflora* in general habit but has shorter sepals, a less densely indumented perianth and uncurved seeds.

Weak, twiggy subshrub to *ca.* 30 cm high and often as wide; hairs on young stems lightly to moderately appressed or semi-appressed hairy to *ca.* 1 mm long, older stems glabrescent. Leaves alternate, sessile or with petiole to *ca.* 0.5 mm long; lamina elliptic to obovate, 5–9 mm long, 1.5–2.5 mm wide, slightly paler beneath, sparsely appressed hairy on lower surface, glabrous or with a very few hairs on upper surface, hairs to 1 mm long. Inflorescence axillary (mostly) and sometimes terminal, of compact, 2–5-flowered clusters; involucral bracts absent or not differentiated from leaves. Flowers bisexual, yellow, often reddish toward the tip; pedicel densely sericeous, *ca.* 0.5 mm long; perianth 5–8 mm long at maturity (fruit developed but before abscission of style portion), ovary portion persisting and falling with fruit, 3–4 mm long, style-portion 2–3 mm long; sepals not or hardly spreading, *ca.* 0.6–1.1 mm long, shorter than tube of style portion; stamens inserted just below sepals, sessile or subsessile; anthers *ca.* 0.5 mm long; style not exserted. Seed fusiform, 2.8–3.2 mm long, acute or subacute, ±equally pointed at either end and widest at the centre; seed coat finely alveolate with alveolae more or less isodiametric, in indistinct ranks (Figs 1a, 2).

***Selected specimens*: NEW SOUTH WALES.** Near Bemboka Walls, Bemboka State Forest, *D.L. Binns 23*, 19.x.1986 (MEL, NSW). **VICTORIA.** Bunyip State Park, *A.C. Beauglehole 72080*, 20.xi.1982 (MEL); Valencia Ck Rd, between Little Scott Ck & Esteppy Yards, 13 miles SE of Mt Wellington, *A.C. Beauglehole 43448*, 31.x.1973 (MEL); 4 miles E of Licola, *A.C. Beauglehole 43386, J.H. Willis & E.A. Chesterfield*, 21.x.1973 (MEL); Mt Dawson, *E.A. Chesterfield 140*, 22.iii.1984 (MEL); Yalmy Forest Management Block, *E.A. Chesterfield 9*, 9.xi.1983 (MEL); Reedy Ck, 6 km NE of Cann River, *J. Piggin s.n.*, 5.v.1976 (MEL); Warbisco Tk, *ca.* 1.7 km NNW of Trapyard Hill, *D.E. Albrecht 3205 & D.G. Cameron*, 12.i.1987 (MEL); Pinnak Rd, 300 m N of Mine Tk, 10.8 km N of junction with Yalmy Rd, *N.G. Walsh 8613, A.J. Brown & A. Messina*, 8.ii.2017 (MEL, CANB); Yalmy Rd, 24 km WSW direct from Goongerah, *N.G. Walsh 8611, A.J. Brown & A. Messina*, 8.ii.2017 (MEL); Mt Kaye, *N.A. Wakefield 3284*, 20.xi.1947 (MEL); Mt Elizabeth Rd *ca.* 4.4 km N of Junction of Tambo and Timbarra Rivers *A. Messina 1527*, 10.x.2019 (MEL).

***Distribution and habitat*:** Known from south-eastern New South Wales (1 record) and scattered localities through Gippsland, Victoria, from near the NSW border to *ca.* 70 km ESE of Melbourne (Figure 3).

Our field observations and notes on herbarium specimens suggest the typical habitat of *P. curviflora* subsp. *fusiformis* is dry open forest with a rather sparse shrub layer. Soil is typically rather shallow and outcropping rocks are common. The aspect is commonly northerly or north-westerly and sometimes rather steep. The recorded elevation range is 145–700 m above sea-level. Associated species in the New South Wales and eastern Victorian sites include *Eucalyptus agglomerata* Maiden, *E. macrorhyncha* F.Muell. ex Benth., *E. polyanthemos* subsp. *vestita* L.A.S.Johnson & K.D.Hill, *E. sieberi* L.A.S.Johnson, *Acacia boormanii* Maiden subsp. *boormanii*, *A. falciformis* DC., *A. gunnii* Benth., *Bossiaea obcordata* (Vent.) Druce, *Comesperma ericinum* DC., *Daviesia latifolia* R.Br., *Dillwynia phylicoides* A.Cunn., *Hibbertia obtusifolia* DC., *Monotoca scoparia* (Sm.) R.Br., *Platysace lanceolata* (Labill.) Druce, *Pomax umbellata* (Gaertn.) Sol. ex A.Rich., *Rhytidosporum procumbens* (Hook.) F.Muell., *Gonocarpus tetragynus* Labill., *Gahnia sieberiana* Kunth., *Stypandra glauca* R.Br. and *Rytidosperma pallidum* (R.Br.) A.M.Humphreys & H.P.Linder. At the one Bunyip State Park site (the westernmost known locality known to date), the vegetation is heathier and more moist, with associated spp. *Eucalyptus cephalocarpa* Blakely, *E. dives* Schauer, *Leptospermum myrsinoides* Schltdl., *Pimelea phylicoides* Meisn., *Dampiera stricta* (Sm.) R.Br., *Bauera rubioides* Andrews, *Xanthosia tridentata* DC., *Gahnia radula* (R.Br.) Benth., *Lomandra filiformis* subsp. *coriacea* A.T.Lee and *Laxmannia orientalis* Keighery.

***Etymology*:** The subspecific epithet, *fusiformis*, is

Figure 3. Distribution of *Pimelea curviflora* subsp. *fusiformis* (triangles) and subsp. *planiticola* (circles) based on herbarium collections at MEL and selected specimens from CANB and NSW.

from the Latin for spindle-shaped, a reference to the distinctive shape of the seed.

Conservation status: *Pimelea curviflora* subsp. *fusiformis* seems to be uncommon at the sites from which it has been collected (specimen notes and pers. observ.), but occurs in sites that are mostly unlikely to be exploited for timber harvesting or agriculture. It is rather rarely collected, but perhaps overlooked due to its rather cryptic habit and flowers. There is no clear case for it to warrant recognition as a threatened taxon under IUCN (2001) criteria, but it is probably fairly described as rare. The Bunyip population was destroyed by fire in March, 2019 and its response has not yet been noted, but from observations at sites further east where fires have occurred in the last decade, it is expected to recover via seed recruitment.

Notes: The new subspecies differs from others within *P. curviflora* in the almost symmetrical, ellipsoid to fusiform seeds (ovoid in the other subspecies) (Figure 1). The near-symmetry of the seeds is apparent when they are still enclosed within the hypanthium remnant. They are distinctly more slender (relative to their length) than other members of the group in Victoria. The seed of subsp. *curviflora* (not illustrated) is of similar overall proportions to that of subsp. *fusiformis*, but it is distinctly curved (banana-shaped). In the short sepals, subsp. *fusiformis* most closely resembles subspp. *subglabrata* and *planiticola*. It further resembles subsp. *subglabrata* in the diffuse, widely branched habit, while the habitat (from notes on herbarium specimens) appears to be broadly similar to, but drier than that of, subsp. *subglabrata*.

Pimelea curviflora subsp. *planiticola* N.G.Walsh & E.M.Schulz subsp. nov.

***Type*: AUSTRALIA.** Victoria, Bacchus Marsh, between Fisken & Vallance Sts, *V. Stajsic 2679*, 25.xi.2001 (holo: MEL 2134990!; iso AD 136393, CANB 554567, NSW 677436, PERTH 6311660)

Resembles subsp. *subglabrata* and subsp. *fusiformis* in the short sepals, but differs from both in having the seed slightly constricted towards the minutely but distinctly uncinate apex. Both the other subspecies have ovoid, non-uncinate seeds. Seeds of subsp. *planiticola* are more strongly uncinate than all other subspecies of *P. curviflora*. It resembles *P. micrantha* somewhat in having a slightly constricted seed, but not as strongly constricted as in that species, which has blunt, 'skittle-shaped' or 'peanut-shaped' seeds (Figure 1d). The texture of the seed coat is much finer than that of *P. micrantha*, with smaller, shallower alveolae, the tubular part of the style portion of the perianth is relatively longer (longer than the sepals; shorter than the sepals in *P. micrantha*), and the growth habit is typically taller and more slender than that of the three taxa noted above.

Erect subshrub or shrub to 50 cm high; young stems densely appressed-hairy with hairs *ca.* 1 mm long, older stems usually glabrescent. Leaves alternate, sessile or with petiole to *ca.* 0.5 mm long; lamina ovate to elliptic, narrowly elliptic, oblong or narrowly obovate, 6–13 mm long, 2–4 mm wide, concolorous or slightly paler beneath, sparsely to moderately hairy on both surfaces (usually sparser adaxially) with appressed hairs to 1 mm long, older leaves sometimes glabrescent. Inflorescence terminal and/or axillary, of compact 4–12-flowered clusters; involucral bracts absent or not differentiated from leaves. Flowers bisexual or female, yellow, yellow-green, or sometimes reddish toward the tip; pedicel densely sericeous, *ca.* 0.5 mm long; perianth 5–7 mm long at maturity (fruit developing but before abscission of style portion), rather densely covered with appressed hairs 0.2–0.6 mm long, denser toward the base; ovary portion 3–3.7 mm long, deciduous style-portion 1.6–2.5 mm long; sepals not or only moderately spreading, 0.6–1.1 mm long, 1–2 times as long as the tubular part of the style portion; stamens inserted just below sepals, almost sessile; anthers *ca.* 0.5 mm long; style not exserted. Seed ovoid, *ca.* 2.5 mm long, acute, distinctly broader proximally than distally, with slight constriction just above midway, and minutely uncinate at apex; seed coat finely textured with alveolae distinctly wider than long, in indistinct ranks, rarely quite smooth (Figs 1b, 4, 5).

***Selected specimens examined*: SOUTH AUSTRALIA.** Section 43, Hundred of Tatiara, 6 km NE of Wolseley, *T. Croft 125*, 20.x.1993 (AD); *ca.* 0.5 km NE of Pooginagoric on road to Wolseley in road reserve on SE side, *P.J. Lang 2356*, 24.xi.1993 (AD); 4.6 km direct NNW of Serviceton (Heritage Agreement 1000), *P.J. Lang BS84-974*, 13.ii.1995 (AD); 50 m NE along Stotts Road from the junction of Bordertown-Frances Rd, Watsons Rd and Pooginagoric-Custon Rd, *T.S. Te 815*, 8.x.2009 (AD). **NEW SOUTH WALES.** River flat near Deniliquin, *W.E. Mulham s.n.*, xi.1979 (MEL, NSW); Cowra township, *E.J. McBarron 9154 bis*, 26.viii.1964 (MEL, NSW); 1 km SE of Munyabba, *B.G. Briggs 4394*, 18.x.1971 (MEL, NSW). **VICTORIA.** Little Desert, 12 km NNW of Minimay, *A.C. Beauglehole 66842*, 28.xi.1979 (MEL); Broughton Roadside Reserve, *A.C. Beauglehole 84071*, 10.ix.1986 (MEL); Natimuk Lake Reserve, *A.C. Beauglehole 86272*, 10.xi.1986 (MEL); Barrabool Flora and Fauna Reserve, *A.C. Beauglehole 85725* (MEL), 17.x.1986; Bacchus Marsh (Maddingley area), *N.G. Walsh 8819 & V. Stajsic*, 23.viii.2018 (AD, MEL); 14 km NNE of Wedderburn, *A.C. Beauglehole 50161*, 12.viii.1975 (MEL); About 1 mile [1.6 km] S of Wunghnu, *T.B. Muir 6889*, 6.xi.1981 (MEL); Barmah National Park, Maconochies Crossing, *V. Stajsic 6946*, 13.iii.2011 (MEL); Bushland Reserve, Webb Rd, Goomalibee, NW of Benalla, *R. Thomas 349*, 10.x.1991 (MEL); Hunter railway siding, NW of Elmore, *P. Foreman 87*, 16.i.1993 (MEL); Terrick Terrick National Park, *W.A. Gebert 350*, 11.ix.2013 (MEL, PAL, RSA); Shepparton State Forest, 1.5 km SW of Shepparton, *G.K. Patterson 558*, 10.x.1980 (MEL); Rabbiters Swamp, E of Balliang, *D. Frood 035/90*, 19.vi.1990 (MEL).

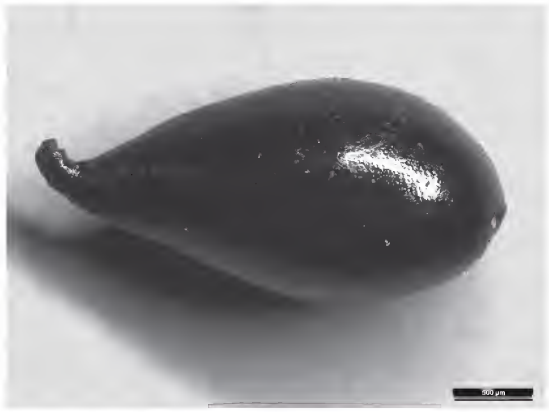

Figure 4. Unusual, smooth-seeded form of *Pimelea curviflora* subsp. *planiticola* (MEL616755). Scale bar = 0.5 mm.

***Distribution and habitat*:** Recorded from south-eastern South Australia (near Bordertown), central and north-western Victoria, south-west plains and south- and central western slopes of New South Wales to as far north at least as Cowra (Figure 3).

Known from grasslands and grassy woodlands on predominantly marine, fluvial and aeolian sediments (Muller 2002), mainly on plains and occasionally in ephemeral swamps, but also on river terraces and gently undulating country. The average annual rainfall is mostly 300–500 mm. Soils are mostly clay loams or clays, sometimes slightly saline. From herbarium sheets, commonly associated species include *Eucalyptus albens* Benth., *E. camaldulensis* Dehnh., *E. largiflorens* F.Muell., *E. melliodora* A.Cunn. ex Schauer, *E. microcarpa* (Maiden) Maiden, *Allocasuarina luehmannii* (R.T.Baker) L.A.S.Johnson, *Acacia* spp., *Duma florulenta* (Meisn.) T.M.Schust., *Haloragis aspera* Lindl., *Anthosachne scabra* (R.Br.) Nevski, *Poa labillardierei* Steud., *Rytidosperma duttonianum* (Cashmore) Connor & Edgar, *Marsilea drummondii* A.Braun.

***Etymology*:** The subspecific epithet, *planiticola*, is from the Latin *planities*, a plain, and *-cola*, dwelling, a reference to the habitat of the taxon.

NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2134990
192 THYMELAEACEAE
Pimelea curviflora R.Br.
var aff subglabrata Threlfall
Coll.: Stajsic, V. 2679 Date: 25 Nov 2001
AUSTRALIA : VICTORIA
Region/District: Midlands/Vic. Volcanic Plain
Locality: Bacchus Marsh, on S side of Ballarat railway line, between Fisken and Vallance Streets. Ref: AMG 55 274500 5825500.
Lat.: 37°41'24"S Long.: 144°26'33"E
Vic. Grid Ref.: N 39.
Notes: Growing on embankment above railwayline, below powerlines, on High level river terrace geology, on reddish coloured soil with pebbles and quartz. Associated with: *Arctotheca calendula, *Avena barbata, Austrostipa bigeniculata, A. scabra, A. setacea, Chloris truncata, Einadia nutans, Enchylaena tomentosa, Enneapogon nigricans,*Erodium crinitum, Euphorbia drummondii, *Lycium ferocissimum, Paspalidium constrictum, *Pentaschistis airoides, Wahlenbergia luteola and Cassinia arcuata.
Small branched shrubs to 30-40 cm high.
About 150 plants of various age classes. Very rare in the region.
Dupls: AD, CANB, MEL (Vic.Ref.Set),NSW, PERTH
NATIONAL HERBARIUM OF VICTORIA (MEL)
HOLOTYPE
P. curviflora subsp. planiticola N.Gidabel & C.E.M.Schulz
Determinavit: N.G.Walsh 7·viii·2019
cm
copyright reserved
TYPE
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA

Figure 5. Holotype of *Pimelea curviflora* subsp. *planiticola* (MEL2134990).

***Conservation status*:** As its habitat is largely relatively fertile plains country, the abundance of subsp. *planiticola* has undoubtedly diminished substantially since settlement and in many districts is now largely confined to remnant roadside vegetation (e.g. through the Victorian Wimmera). Nonetheless, it is known from numerous conservation reserves and has a wide distributional range. Specimen notes also often record it as occurring in small populations, so it is probably correctly regarded as regionally rare at least, but it is considered unlikely to qualify for listing under IUCN (2001) criteria.

***Notes*:** While the slightly constricted seed of subsp. *planiticola* suggests a relationship with *P. micrantha*, it is still considered nearer to the range of seed shapes and textures in *P. curviflora* than to the very distinctive shape and surface texture (strongly alveolate with alveolae in more or less distinct rows) of *P. micrantha* (see Figure 1). One specimen of subsp. *planiticola* (*G.K. Patterson 558,* Shepparton area, Victoria, MEL616755) was found with virtually smooth seeds (Figure 4), but this is not the normal state within the taxon. The short perianth also suggests a relationship with *P. micrantha*, but the sepals are up to twice as long as the tubular part of the style portion, slightly longer than those of *P. micrantha* which are shorter than or equal to the tubular part of the style portion.

The mostly semi-arid habitat of subsp. *planiticola* distinguishes it from other subspecies of *P. curviflora* in Victoria. In overall appearance (habit, indumentum) it is most likely to be confused with subsp. *gracilis* (a species from relatively high-rainfall areas in Victoria) or with *P. micrantha* with which it may be sympatric (e.g. Bacchus Marsh and Wimmera areas of Victoria).

New Combinations

Pimelea curviflora subsp. *acuta* (Threlfall) N.G.Walsh comb. nov.

P. curviflora var. *acuta* Threlfall, *Brunonia* 5:190 (1983)

***Type*:** AUSTRALIA. N.S.W. Two Sticks Rd, *ca*. 1.6 km N of Picadilly Circus, 15 Nov. 1961, *P.J. Darbyshire 525* (holo: NSW 651525 photo seen; iso: A 443770 photo seen, CANB 86039 *n.v.*, MEL 50775 !).

Pimelea curviflora subsp. *divergens* (Threlfall) N.G.Walsh comb. nov.

P. curviflora var. *divergens* Threlfall, *Brunonia* 5:189 (1983)

***Type*:** AUSTRALIA. N.S.W. Currabubula district, 31 May 1940, *per Glenfield Veterinary Research Stn 40/812* (holo: NSW 178603 photo seen; iso: SYD *n.v.*, NSW 653308 photo seen).

Pimelea curviflora subsp. *sericea* (Benth.) N.G.Walsh comb. nov.

P. curviflora var. *sericea* Benth., *Fl. Austral.* 6:31 (1873)

***Type*:** AUSTRALIA. N.S.W. North Bathurst, *A. Cunningham* Nov. 183/1822 (lecto: K 00900018 photo seen, *fide* S. Threlfall, *Brunonia* 5: 187 (1983); isolecto: K 00900019 photo seen).

Pimelea curviflora subsp. *subglabrata* (Threlfall) N.G.Walsh comb. nov.

P. curviflora var. *subglabrata* Threlfall, *Brunonia* 5:189 (1983)

***Type*:** AUSTRALIA. N.S.W. 5 miles [8 km] S of Wollar, 1 Oct. 1952, *H.S. McKee 315* (holo: NSW 127778 !; iso: SYD *n.v.*).

Typification

Typification of some taxa in the *Pimelea curviflora* - *P. micrantha* complex was deficient in the accounts by Threlfall (1983) and Rye (1988, 1990), undoubtedly partly due to the greater difficulty during that period in locating types. With the advent of online delivery of Type images, e.g. through the JSTOR Global Plants imaging project (http://plants.jstor.org/, accessed 31 May 2019), the opportunity is taken here to clarify the typification of *P. curviflora* (and its synonyms *P. muelleri* Meisn. and *P. thymifolia* C.Presl), two of its subspecies, and *P. micrantha*.

Pimelea curviflora R.Br., *Prodr*. 362 (1810)

***Type*:** AUSTRALIA. N.S.W. Port Jackson area, 1802, R.Br. s.n.(Lecto: here chosen BM 000895082 photo seen; isolecto: K 900020, K 900021, MEL 50703 !, MEL 51300 !, S 09-18564 photo seen).

***Notes*:** Threlfall (1983) cited the BM specimen as the holotype, pointing out that the date on Brown's label (June 1802) was not in agreement with his notes (17.v.1802). Although a number of apparent duplicates of Brown's type have been brought to light via JSTOR (http://plants.jstor.org, accessed 31 May 2019), none has a date of May 17, supporting Threlfall's assertion that the BM specimen is the most appropriate type; however we consider it better treated as a lectotype than a holotype

in accordance with Articles 9.4 and 9.19 of the Code (Turland *et al*. 2018). Threlfall (*loc. cit*.) transcribed Brown's label in Latin: 'in pratis (unreadable word) prope Sydney, (unreadable word) prope Parramatta, June 1802 …' Having inspected the image on JSTOR, the unreadable words were found to be 'rarius' and 'crebrius', rendering Brown's note (translated to English) as 'In meadows, rare near Sydney, frequent near Paramatta.'

In addition to the types noted above, there is an unnumbered specimen in LINN ex herb Banks from Port Jackson but without collector, and 2 sheets at BRI (both numbered AQ023515) labelled '*Pimelea curviflora*, Port Jackson' (undated) in Brown's hand. These are likely to isolectotypes.

Pimelea curviflora var. sericea Benth., *Fl. Austral.* 6:31 (1873)

Bentham (1873) synonymised *Pimelea propinqua*

Key to *P. micrantha* and *P. curviflora* subspecies

1 Sepals <1 mm long … 2

1 Sepals >1 mm long … 5

2 Seed skittle-shaped with a distinct constriction at, or shortly above, midpoint, apex obtuse; style portion of tube no longer than sepals; leaves (at least those subtending inflorescences) and perianth densely sericeous (semi-arid areas of WA, SA, NSW, Vic.)… *P.* ***micrantha***

2 Seed more or less ovoid, apex acute; style portion of tube slightly longer than sepals; leaves glabrescent to moderately appressed-hairy … 3

3 Fruit and seed slightly constricted below the minutely but conspicuously uncinate apex (south-east SA, south-western plains NSW, western and northern plains Vic)… subsp. ***planiticola***

3 Fruit and seed not constricted below the apex, not uncinate … 4

4 Fruit and seed more or less symmetric, almost fusiform; sepals up to twice as long as the tubular part of the style portion of corolla; leaves with appressed hairs on abaxial (and usually adaxial) surface; (far south-east NSW, south-eastern VIC)… subsp. ***fusiformis***

4 Fruit and seed distinctly asymmetric, ovoid; sepals at least 2.5 times as long as the tubular part of the style portion of corolla; leaves lacking hairs, or a few only on abaxial surface (Wollongong-Newcastle area NSW) … subsp. ***subglabrata***

5 Fruit and seed curved, not or barely wider in basal half and more or less evenly and equally tapered at base and apex; (Sydney area NSW)… subsp. ***curviflora***

5 Fruit and seed usually asymmetric but not curved, distinctly wider in basal half … 6

6 Leaves no more than 3 times longer than wide, margins distinctly and narrowly recurved; hairs of younger stems 2–3 mm long; perianth mostly 10–13 mm long at maturity; (Southern Highlands, NSW) … subsp. ***acuta***

6 Leaves usually >3 times longer than wide (sometimes less in subsp. *gracilis*), margins flat or rather indistinctly incurved or recurved; hairs of younger stems to 2.5 mm long; perianth mostly <10 mm long (but to 12 mm long in subsp. *divergens*) … 7

7 Leaves usually distinctly discolorous, usually obtuse; plants typically erect, slender, single-stemmed from base; inflorescences mostly 3–7-flowered; mostly forest areas (?SA, Qld, NSW, Vic, Tas) … subsp. ***gracilis****

7 Leaves usually concolorous, usually acute; plants commonly several-stemmed from base with a persistent woody taproot; inflorescences mostly 5–15-flowered; mostly grasslands … 8

8 Longest hairs 1.2–2.5 mm long; fruit gibbous at base, at least half as wide as long, pericarp with an erect, rather dense terminal tuft of hairs; perianth to 12 mm long (south-eastern Qld, north-eastern NSW) … subsp. ***divergens*****

8 Longest hairs to 1.5 mm long; fruit not gibbous, *ca*. 3 times as long as wide, pericarp lacking a terminal tuft of hairs, or rarely with a few weak hairs at apex; perianth to *ca*. 8 mm long (SA, NSW, VIC, TAS) … subsp. ***sericea******

* Subsp. (as var.) *gracilis* was cited by Rye as occurring in SA, with a specimen cited from 'W end of Torrens Gorge' (*A. Spooner 1135*). We have not seen this specimen, but others labelled as var. *gracilis* at MEL have been redetermined to be either subsp. *sericea* or subsp. *planiticola*.

**A specimen of subsp. (as var.) *divergens* from Wickliffe Victoria (s. coll., 9.xi.1903, MEL2180317) was reported by both Rye and Threlfall, but this specimen appears to be quite typical of subsp. *sericea* and has been redetermined.

***Threlfall and Rye both give the distribution of subsp. (as var.) *sericea* as including Queensland. Bean (2017) notes that all Queensland specimens of this variety seen by him belong with the superficially very similar subsp. (as var.) *divergens*. No Queensland specimens of subsp. *sericea* were seen at MEL. Some Tasmanian specimens of subsp. *sericea* that had been treated as an undescribed taxon, *P.* sp. 'Tunbridge' were considered a threatened taxon (e.g. https://www.threatenedspecieslink.tas.gov.au/Pages/Pimelea-sp-Tunbridge.aspx, accessed 31 May 2019), but these are typical subsp. *sericea* in both habit and grassland habitat. Some confusion appears to have arisen about the circumscription of subsp. *sericea* in Tasmania from Rye's citation of its occurrence on Flinders Island. All Flinders Island material of *P. curviflora* at HO and MEL is subsp. *gracilis*.

Meisn. under *P. curviflora* var. *sericea*. No particular type was noted, but Threlfall's (1983) lectotypification of Meisner's name, based on a Cunningham specimen at K ('North Bathurst, Nov. 183/1822') is appropriate. This is K00900018, but another element is mounted on the same sheet 'slender shrub in fertile plain, N of Bath^{r}' [Bathurst], as K00900019. It also apparently a Cunningham collection (signified by a pencilled 'C') and is likely part of the same collection, resembling closely K00900018. It is treated here as an isolectotype. A Cunningham collection at NY (386352) 'Valleys near Bathurst, N.S.Wales, 1822' is almost certainly another isolectotype and would have been used by Meisner in naming *P. propinqua* (he may or may not have seen the Kew specimens).

Rye (1990) notes a possible isotype at G-DC, but the Cunningham specimen therein, inspected from microfiche, has no locality and appears to be dated 1836, so is not an isolectotype.

The K sheet with the two pieces (00900018 and 00900019) has been labelled by Cunningham as '*Pimelea congesta* A.Cunn.' This name was never validly published, although cited by Bentham as a synonym under *P. curviflora* var. *sericea*. Threlfall (1983) included it as a *nomen nudum* under *P. hirsuta* Meisn. (although attributed the name to Richard Cunningham (R.Cunn.) rather than his brother Alan (A.Cunn.). Bentham (1873) had made the note under *P. hirsuta*, '*P. hirsuta* R.Cunn. in several herb., not of A.Cunn.' It is not clear which herbaria Bentham was referring to here, there being no collections identified as *P. congesta* R.Cunn. encountered in the present study.

***Pimelea muelleri* Meisn.**, *Linnaea* 25:351 (1854).

Bentham included *Pimelea muelleri* in *P. curviflora* var. *curviflora* rather than var. *sericea*, but his concept of var. *curviflora* was very broad. Threlfall (1983) synonymised *P. muelleri* under *P. curviflora* var. *sericea* which is the best fit of currently named taxa. She nominated a G-DC specimen collected by Mueller at Holdfast Bay in South Australia as the lectotype and other specimens at MEL as possible syntypes. There are at MEL five Mueller collections of this from Holdfast Bay (MEL 51201, MEL 51299B, MEL 51321, MEL 59270, MEL 59272) and one at NY (1104574), all of similar appearance and presumably duplicates. These specimens are either dated 1847 or undated – a January 1851 collection is in late fruit and is clearly not of the same gathering. The 1847 collections are reasonably treated as isolectotypes. Specimens at FR (036146, photo seen), G (190897, photo seen) and MEL (59271!), labelled simply 'Nov. Holland. Meridional.' (i.e. South Australia), are of similar appearance to the isolectotypes noted above and may also be isolectotypes.

Collections by Behr 'inter Gawlertown et Lyndoch Vale' were listed by Meisner along with Mueller's Holdfast Bay collections, and two specimens of this gathering are at MEL (51203 and 51299A) forming the residual syntypes of *P. muelleri*. It is likely that other examples of the Behr collections exist, most likely at G and/or NY.

***Pimelea thymifolia* C.Presl**, *Botanische Bemerkungen*: 107 (1845)

***Type*: AUSTRALIA.** Novae Hollandiae [Sydney region, N.S.W.], 1823, *Sieber 205* (lecto: (here chosen): PRC 456580 photo seen; isolecto: H 1385484 photo seen, H 1568440 photo seen, MEL 51251 p.p. !, MEL 61290 p.p. !, MO 3498383 photo seen, PRC 456577 photo seen, PRC 456578 photo seen, PRC 456579 photo seen, PR 615838 photo seen, S 09-20908 photo seen, W 0045017 photo seen, W 0045018 photo seen, W 0045019 photo seen, W 0045239 photo seen),

Pimelea thymifolia was treated by Threlfall (1983) and subsequently others (e.g. Rye 1990; Australian Plant Census: http://www.chah.gov.au/apc/index.html; accessed 4 Jan 2019) as a synonym of *P. curviflora*. Threlfall cited only one specimen (MEL) and treated it as an isotype. Subsequently, many further specimens of *Sieber 205* have been located. The specimen from the herbarium at Charles University, Prague (PRC), noted as the principal 'home' of Presl's collections (Stafleu & Cowan 1976–1988), has been chosen as the lectotype (Figure 6), but numerous isolectotypes exist, a testament to the zealous collecting habits of Sieber (see Ducker, 1990). Presumably further examples of *Sieber 205* exist but are yet to be revealed.

Presl noted his *Pimelea thymifolia* (based on *Sieber 205*) differed from *P. curviflora* in the leaves and the perigonium tube (i.e. the hypanthium: 'perigonii … tubo recto'). There are no substantial differences at all in the leaves of *Sieber 205* and the type of *P. curviflora* at MEL. Specimens of *Sieber 205* at MEL showed the

DATABASED
HERBARIUM UNIVERSITATIS CAROLINAE, PRAGA
PRC
Fl. Novæ Holl. No. 205.
Fl. Novæ Holl. No. 205.
cm 0 1 2 3 4 5 6 7 8 9 10
copyright reserved
HERBARIUM UNIVERSITATIS CAROLINAE PRAGENSIS
PRC
LECTOTYPUS
HERBARIUM UNIVERSITATIS CAROLINAE PRAGENSIS – PRC
Lectotype of Pimelea thymifolia C. Presl, Abh. Königl. Böhm. Gesell. Wiss., ser. 5, vol. 3: 537. 1845
Based on information from Neville Walsh [Royal Botanical Garden Victoria, Australia] this specimen was selected as a lectotype. The handwriting on the lower label, at least the generic name is probably of C. Presl
Accepted name: Pimelea curviflora R. Br. var. curviflora [P. Mráz, August 2018]
BOTANISCHES INSTITUT DER DEUTSCHEN UNIVERSITÄT IN PRAG.
HERBARIUM UNIVERSITATIS CAROLINAE PRAGENSIS – PRC
Exsiccate collection SIEBER, HERBARIUM FLORAE NOVAE HOLLANDIAE issued by FRANZ WILHELM SIEBER (* 30. Mar. 1789 in Praha – † Dec. 1844 in Praha). Plants were collected by SIEBER during his expedition in 1823, and distributed in several issues in ca. 1824-1828.
Herbarium Universitatis Carolinae, Praga
PRC 456580

Figure 6. Lectotype of *Pimelea thymifolia* (PRC 456580).

typical flower and fruit of *P. curviflora*. Some of the Sieber specimens were in early flower when collected, and it is possible that those available to Presl were at this stage (although photographs of specimens at PRC appear to show curved flowers and fruits and at least two of these specimens had been seen by Presl.). The characteristic curvature of the flowers of *P. curviflora* becomes particularly apparent at maturity or even after the 'style portion' abscises to leave the developing falcate fruit.

***Pimelea micrantha* F.Muell. ex Meisn.,** *Linnaea* 26: 351 (1854).

***Type*: AUSTRALIA.** "Ultra Saltcreek, Nov. (Dr.Behr). Circa Enfield, Austral. aur. Janr. (Dr. F. Müller)" (lecto here designated: Enfield N. Holl. Austr., Jan 1852, *F. Mueller s.n.* (NY photo seen; isolecto: MEL 52308 p.p. !; probable isolecto: HBG photo seen; residual syntype: Ultra Saltcreek, Nov., *Dr.Behr s.n.*, MEL 51308 p.p. !

Threlfall cited the Enfield specimen at NY as holotype. This is incorrect as two collections were referenced by Meisner in the protologue. Meisner's herbarium is at NY (Stafleu and Cowan 1976–1988) and the specimen there is here nominated as the lectotype. A mixed sheet at MEL (MEL51308) has labels for both the localities (Salt Creek and Enfield) cited in the protologue. Of the elements on the sheet, one resembles that at NY, while one is of a smaller-leaved plant – presumably the Salt Creek component. The elements matching the lectotype have been indicated and are treated as isolectotypes and the 'mismatching' element is treated as the residual Salt Creek syntype.

Putative types have been imaged on JSTOR (http://plants.jstor.org/, accessed 31 May 2019) from K and HBG, but the Kew sheet is labelled 'Murray River, J.D.' (undated). The collector is almost certainly John Dallachy, who collected for Mueller in north-west Victoria. This specimen has no type status. The HBG sheet has a 'Plantae Mullerianeae' label, so is probably a Mueller collection, and the locality is given as simply 'Nov. Holland. meridional.' (i.e. South Australia). The specimen is a fair match for the Enfield gatherings at NY and MEL and is therefore treated here as a likely isolectotype.

Acknowledgements

We are grateful to Dan Duval, South Australian Seed Conservation Centre, for kindly photographing the seeds that comprise Figs 1 and 2, Austin Brown, Andre Messina and Val Stajsic (all MEL) for assistance in the field, and to Andre for assisting with the preparation of figures, to Alison Vaughan (MEL) who prepared the distribution map of the new subspecies and to Patrik Mráz, Curator, Charles University Herbarium, Prague for unearthing and arranging photography of type material at that institution.

This study was undertaken as part of the RBGV Jim Willis Summer Studentship (awarded to E.S. in 2017). We are indebted to the late Roger Riordan AM, and Maggie and Max Richards for their generous support of this program.

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Muelleria

38: 125-126

Published online in advance of the print edition, 17 February 2020

ROYAL BOTANIC GARDENS VICTORIA

Erratum: Brown, A.J. (2019) *Lachnagrostis* (Poaceae) in the Highlands of New Guinea. *Muelleria* 37, 65–75

Despite being correctly portrayed in the PDF (online) version of the article named above, an error in the printing source file saw the incorrect image included for Figure 1 on page 70 of the hardcopy of *Muelleria* Volume 37, 2018–2019.

This error duplicated an image from a separate article featured in the same volume, namely Figure 1 on page 81.

The correct image is presented overleaf.

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ISSN: 0077-1813 (print) · ISSN: 2204-2032 (online)

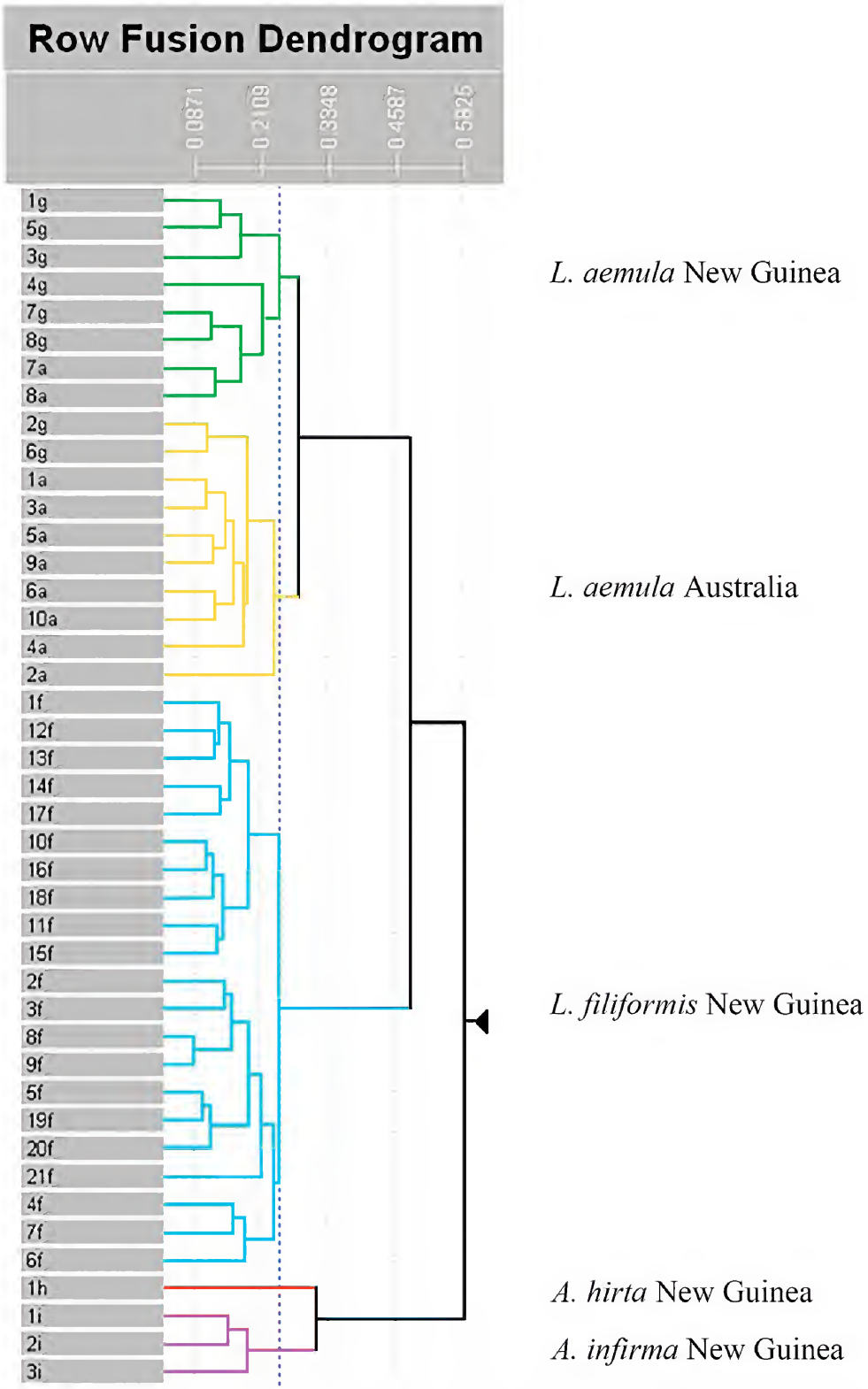

Figure 1. PATN Row Fusion Dendrogram from Unweighted Pair Group Method with Arithmetic Mean (UWGMA) Hierarchical Clustering analysis of Lachnagrostis and Agrostis morphological character assessment.

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***Muelleria* volume 37 was distributed on 10 May 2019.**

Muelleria

Royal Botanic Gardens Victoria
Birdwood Avenue, Melbourne
Victoria, Australia
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ISSN 0077-1813

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